Scale Units and Display Counters
Linear Scale DRO Systems

Catalog No. E13000

Linear Scales & Counters

Mitutoyo

Accurate, yet Affordable, DRO System from Mitutoyo

Mitutoyo's Linear Scale System tightly couples linear scale units with dedicated Digital Readout (DRO) units to offer accurate detection and display of axial displacement for machine tools and measuring equipment. The Linear Scale System can be configured to best meet your specific application, whether it be machining or measuring, just by choosing a suitable combination of scale unit and display unit. Scale units have many measuring length ranges and the display units feature remote zero setting, switchable resolution and multipurpose one-touch macro keys. The Linear Scale System has superior ease-of-use and is reliable, both of which are features that can dramatically improve machining accuracy and efficiency.

Table of Contents

Scale Unit Selection Guide 3
AT715, ABSOLUTE and High Environmental Resistance Type 4
AT103, Standard-size Type 6
AT113, Slim Type 8
AT116, Slim and Economy Type 9
AT112-F, Super Slim Type 10
AT181, Plunger Type 11
Scale Unit Features 12
Display Unit Selection Guide 13
KA Counter 14
KLD-200 Counter 15
Display Unit Functions 16
Connecting to External Devices 18
Traceability System 22
Optional Accessories 24
Optional Adapters 26
Precautions when mounting and handling Linear Scales 28
Scale systems for various multi-axis machine tools 31

Features of the Linear Scale System

- Digital counter value display allows quick and accurate readout of displacement. Working efficiency thus greatly improved.
- Zero-setting or presetting possible at any position. Versatile functions eliminate calculations or complicated key operations for positioning.
- Various external output features allow output of current display values or various data to external devices such as PCs or sequencers. Easy data processing can be performed.
- Two types of display units available: high-performance type and limit signal type.
- Both linear scale and display units conform to CE marking standards. They also comply with the hazardous substances restriction in the RoHS directive (2006).

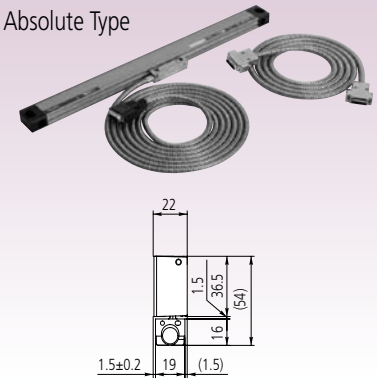
Ultra Precision Manufacture 11 Meters Underground

Mitutoyo Kiyohara Plant, which is a factory exclusively for the production of Linear Scales and other precision scales, has a complete system for producing master scales to be used in finished products, such as CMMs, vision measuring systems, profile projectors, and measuring microscopes. To improve the accuracy of scales and quality control technologies, the integral laboratory at the Kiyohara Plant was constructed eleven meters underground. It provides an optimum environment (cleanliness factor: 100) for the ultra-precision manufacture and evaluation of scales. Its unique design and construction isolates the laboratory from external vibrations and ensures minimal variations in temperature and humidity.

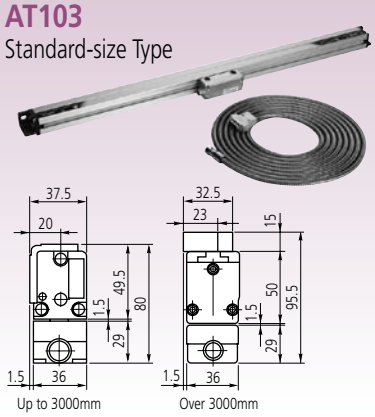
Mitutoyo

Scale Unit Selection Guide

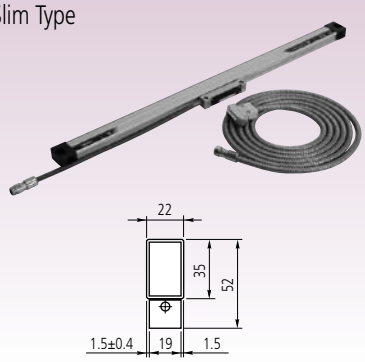
AT715
Absolute Type



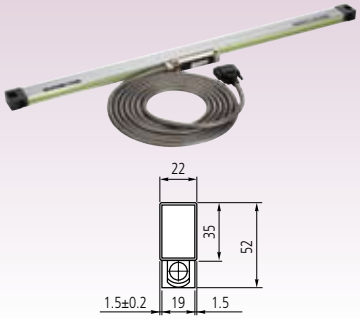
AT103
Standard-size Type



AT113
Slim Type

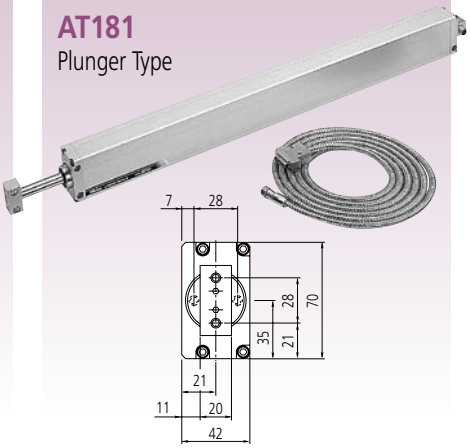


AT116
Economy and Slim Type



AT112-F
Super Slim Type

AT181
Plunger Type



Specifications

Model	AT715	AT103	AT113, AT116	AT112-F	AT181
Measurement method	Electromagnetic induction system	Photoelectric (transparent linear encoder)			
Light source	—	LED			
Receptor	—	Phototransistor			Photodiode
Output wave form	—	2-phase sine curves with a phase difference of 90°			
Effective length (for high accuracy type)	100 - 3000mm	100 - 6000mm (100 - 2000mm)	100 - 1500mm (100 - 1500mm)	50 - 1020mm (50 - 1020mm)	100 - 600mm (100 - 600mm)
Accuracy* [high accuracy type] * Excluding quantizing error of ±1 count	±5μm (Effective length: 100 - 500mm) ±7μm (Effective length: 600 - 1800mm) ±10μm (Effective length: 2000 - 3000mm)	(5+5L_0/1000)μm*1 [(3+3L_0/1000)μm]	(5+5L_0/1000)μm [(3+3L_0/1000)μm*2]	(5+5L_0/1000)μm [(3+3L_0/1000)μm]	(5+5L_0/1000)μm [(3+3L_0/1000)μm]
Maximum response speed	50m/min.	120m/min.*3	120m/min. (50m/min.: AT116)	50m/min.	50m/min.
Scale reference point	Absolute system	At every 50mm interval			
Linear expansion coefficient	—	(8±1)x10^{-6}/°C			
Power supply	5V±5% DC	5V±5% DC			
Max, current consumption	70mA	70mA*4 (60mA: AT113, AT116)			70mA
Operating temperature	0°C to 45°C				
Storage temperature	-20°C to 70°C				
Relative humidity	20 - 80%RH				
Head Cable length	—	—	*6	0.3m	—
Sliding force	5N or less	5N or less			6N or less
Single cable*5	Standard accessory (refer to individual specifications for the length)				
Dust/water protection level	IP67	IP53			IP54

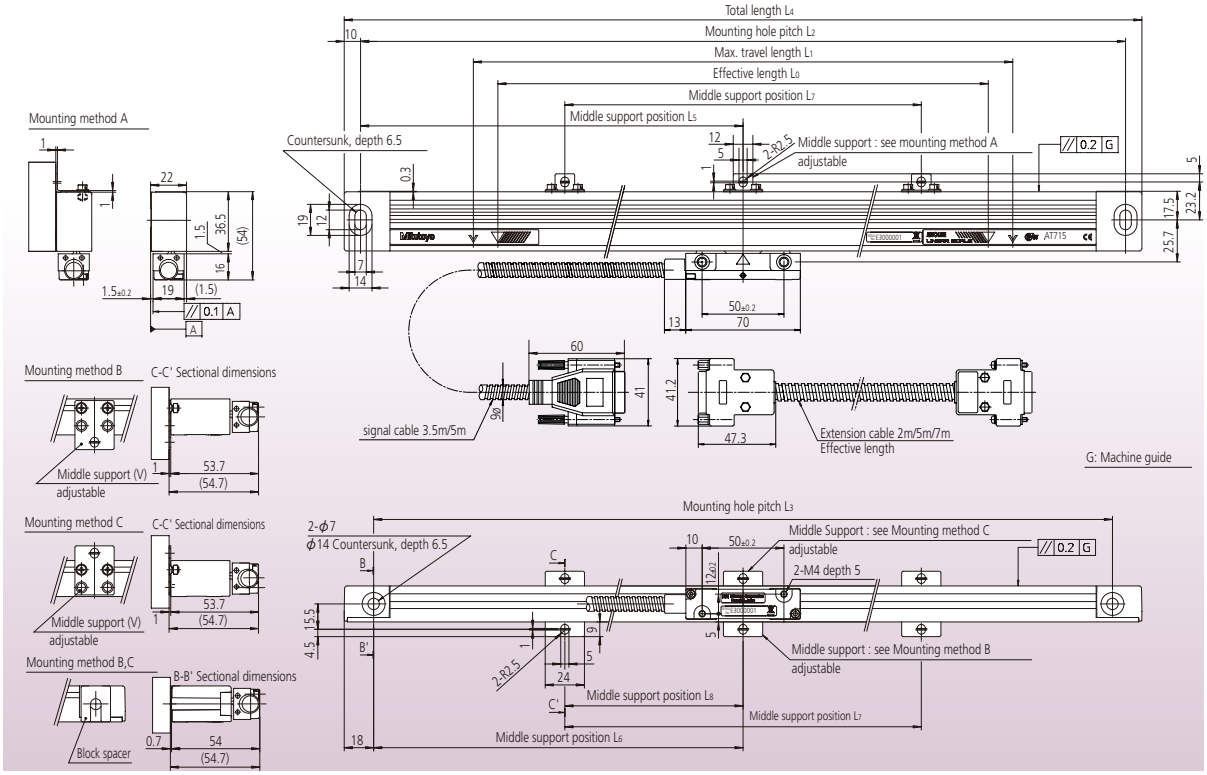
*1: (5+8L_0/1000)μm for models over 3250mm effective length *2: not available for AT116 *3: 50m/min. for models over 3250mm effective length *4: 140mA for models over 3250mm effective length
*5: Vinyl-coated type single cable and extension cable are available on request. *6: AT103:0.3m AT116: Without head cable

AT715, ABSOLUTE and High Environmental Resistance Type

Using ABSOLUTE® Electromagnetic Induction System

ABSOLUTE IP67 www.tuv.com TÜVRheinland ID:0000007295

- Dust- and watertight IP67



Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective length L_0	Maximum travel length L_1	Mounting hole pitch L_2	Mounting hole pitch L_3	Mounting hole pitch L_4	Middle support positions L_5	L_6	L_7	Signal cable length
539-801 / AT715-100	100(4")	120(4.72")	258(10.16")	242 (9.53")	278(10.94")	—	—	—	3500 (137.80)
539-802 / AT715-150	150(6")	170(6.69")	308(12.13")	292 (11.50")	328(12.91")	—	—	—	
539-803 / AT715-200	200(8")	220(8.66")	358(14.09")	342 (13.46")	378(14.88")	—	—	—	
539-804 / AT715-250	250(10")	270(10.63")	408(16.06")	392 (15.43")	428(16.85")	—	—	—	
539-805 / AT715-300	300(12")	330(12.99")	468(18.43")	452 (17.80")	488(19.21")	—	—	—	
539-806 / AT715-350	350(14")	380(14.96")	518(20.39")	502 (19.76")	538(21.18")	—	—	—	
539-807 / AT715-400	400(16")	430(16.93")	568(22.36")	552 (21.73")	588(23.15")	—	—	—	
539-808 / AT715-450	450(18")	480(18.90")	618(24.33")	602 (23.70")	638(25.12")	—	—	—	
539-809 / AT715-500	500(20")	540(21.26")	678(26.69")	662 (26.06")	698(27.48")	339(13.35")	331(13.03")	—	
539-811 / AT715-600	600(24")	640(25.20")	778(30.63")	762 (30.00")	798(31.42")	389(15.31")	381(15.00")	—	
539-813 / AT715-700	700(28")	740(29.13")	878(34.57")	862 (33.94")	898(35.35")	439(17.28")	431(16.97")	—	
539-814 / AT715-750	750(30")	780(30.71")	918(36.14")	902 (35.51")	938(36.93")	459(18.07")	451(17.76")	—	
539-815 / AT715-800	800(32")	840(33.07")	978(38.50")	962 (37.87")	998(39.29")	489(19.25")	481(18.94")	—	
539-816 / AT715-900	900(36")	940(37.01")	1078(42.44")	1062 (41.81")	1098(43.23")	539(21.22")	531(20.91")	—	5000 (196.85)
539-817 / AT715-1000	1000(40")	1040(40.94")	1178(46.38")	1162 (45.75")	1198(47.17")	589(23.19")	581(22.87")	—	
539-818 / AT715-1100	1100(44")	1140(44.88")	1278(50.31")	1262 (49.69")	1298(51.10")	424(16.69")	416(16.38")	430(16.93")	
539-819 / AT715-1200	1200(48")	1240(48.82")	1378(54.25")	1362 (53.62")	1398(55.04")	459(18.07")	451(17.76")	460(18.11")	
539-820 / AT715-1300	1300(52")	1340(52.76")	1478(58.19")	1462 (57.56")	1498(58.98")	494(19.45")	486(19.13")	490(19.29")	
539-821 / AT715-1400	1400(56")	1440(56.69")	1578(62.13")	1562 (61.50")	1598(62.91")	524(20.63")	516(20.31")	530(20.87")	
539-822 / AT715-1500	1500(60")	1540(60.63")	1678(66.06")	1662 (65.43")	1698(66.85")	559(22.01")	551(21.69")	560(22.05")	
539-823 / AT715-1600	1600(64")	1640(64.57")	1778(70.00")	1762 (69.37")	1798(70.79")	459(18.07")	451(17.76")	430(16.93")	
539-824 / AT715-1700	1700(68")	1740(68.50")	1878(73.94")	1862 (73.31")	1898(74.72")	479(18.86")	471(18.54")	460(18.11")	
539-825 / AT715-1800	1800(72")	1840(72.44")	1978(77.87")	1962 (77.24")	1998(78.66")	459(18.07")	451(17.76")	530(20.87")	

Extension cable*

Order No.	Cable length
09AAB674A	2m (6.5 feet)
09AAB674B	5m (16.4 feet)
09AAB674C	7m (22.9 feet)

Mounting parts (provided as standard)

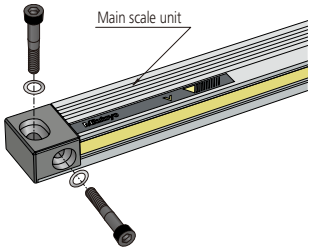
Items included	• Hex-socket head screw (M6x25)	2 pcs.	• Plain washer (4mm nominal)	2 pcs.
	• Hex-socket head screw (M4x25)	2 pcs.	• Cable clip	6 pcs.
	• Hex-socket head screw (M4x8)	6 pcs.	• Spacer (0.3, 0.4, 0.5, 0.6mm)	1 pc. each
	• Plain washer (6mm nominal)	2 pcs.		

*: Use an extension cable so that the total length including the signal cable is less than 15m.

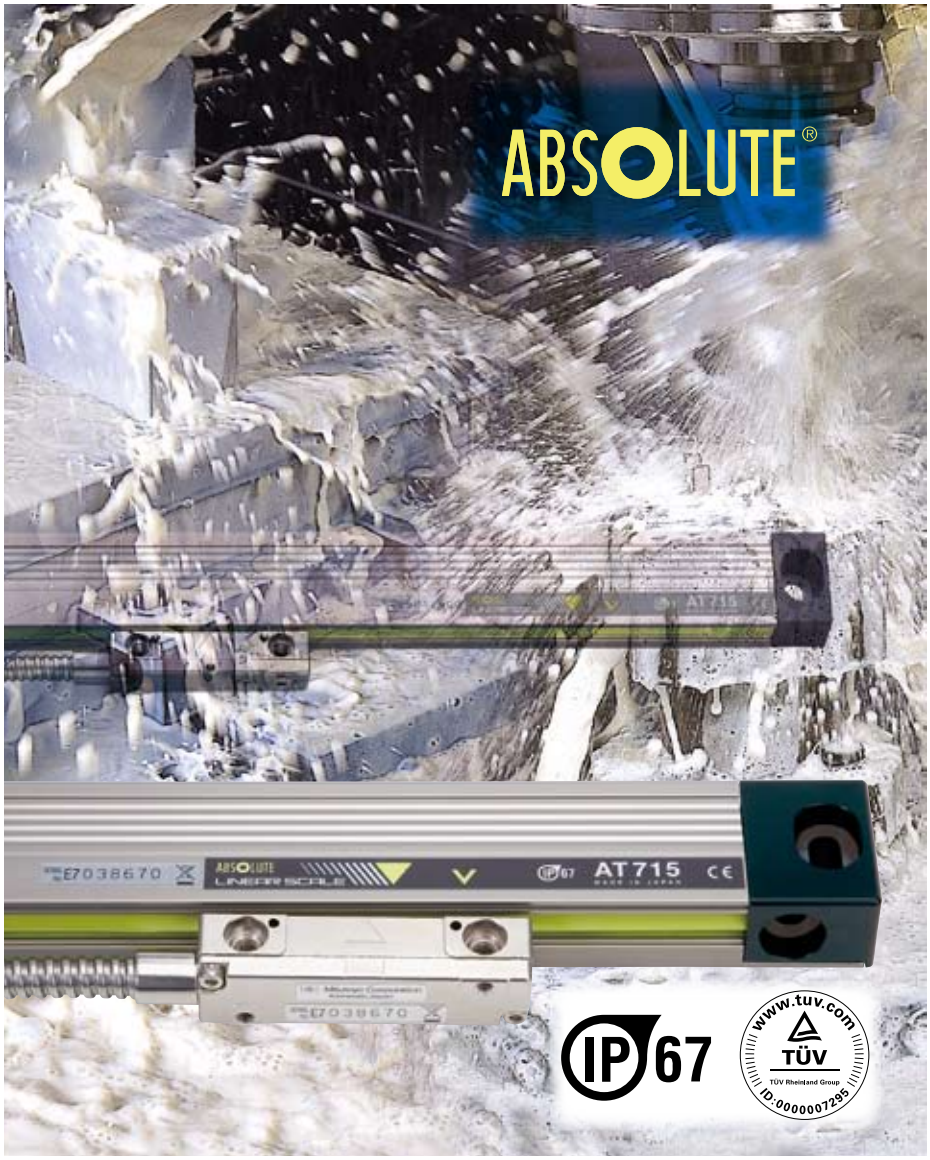
Mitutoyo

Features

- Employs the ABSOLUTE® electromagnetic induction system* to achieve IP67 environmental resistance.
- Detects and outputs an absolute position - no reference point setup needed at every power-on.
- An abnormal calculation doesn't accumulate even if the calculation mistake is generated by electrical noise.
- It is the most suitable scale to mount on the X-axis of a small lathe.
- Two mounting directions of the main scale unit allows easy mounting on a machine tool with difficult mounting arrangements.



* Patent registered
(Japan, USA, India, China, Germany, UK, France, Switzerland)



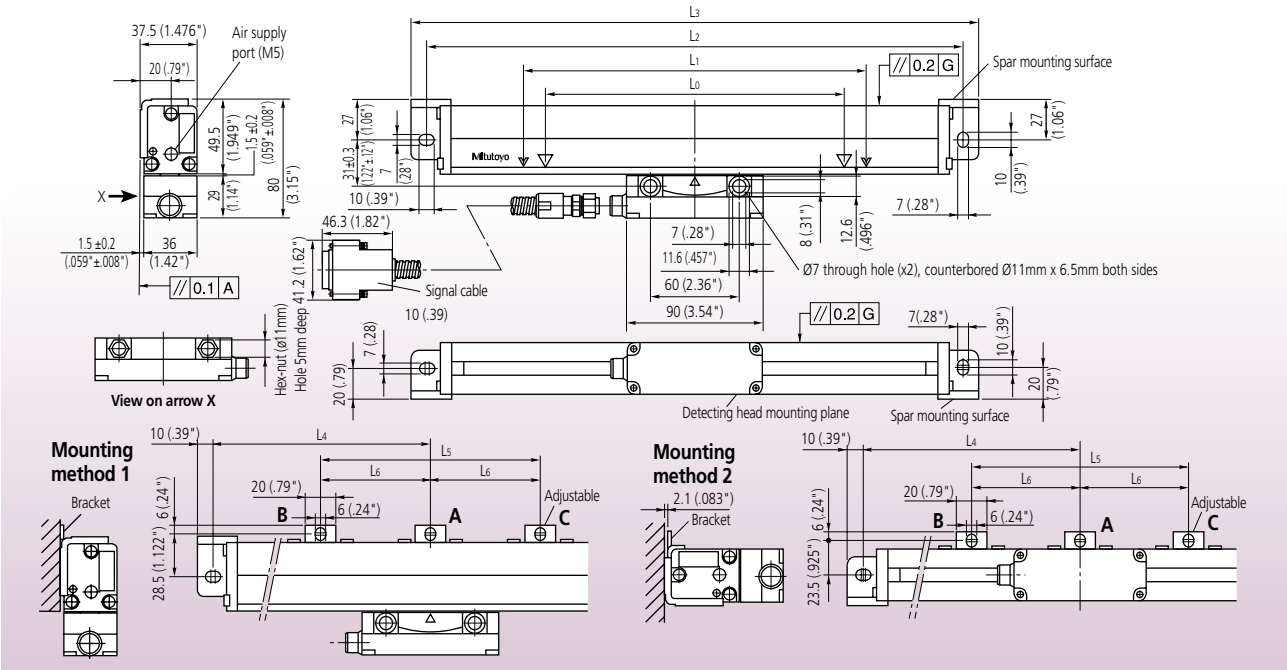
Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective length L_0	Maximum travel length L_1	Mounting hole pitch L_2	Mounting hole pitch L_3	Mounting hole pitch L_4	Middle support positions L_5	Middle support positions L_6	Middle support positions L_7	Signal cable length
539-860 / AT715-2000	2000(80")	2040(80.31")	2178(85.75")	2162 (85.12")	2198(86.54")	539(21.22")	531(20.91")	550(21.65")	5000 (196.85)
539-861 / AT715-2200	2200(88")	2240(88.19")	2378(93.62")	2362 (92.99")	2398(94.41")	469(18.46")	461(18.15")	480(18.90")	
539-862 / AT715-2400	2400(96")	2440(96.06")	2578(101.50")	2562 (100.87")	2598(102.28")	509(20.04")	501(19.72")	520(20.47")	7000*1 (275.60)
539-863 / AT715-2500	2500(100")	2540(100.00")	2678(105.43")	2662 (104.80")	2698(106.22")	529(20.83")	521(20.51")	540(21.26")	
539-864 / AT715-2600	2600(104")	2640(103.94")	2778(109.37")	2762 (108.74")	2798(110.16")	549(21.61")	541(21.30")	560(22.05")	
539-865 / AT715-2800	2800(112")	2840(111.81")	2978(117.24")	2962 (116.61")	2998(118.03")	489(19.25")	481(18.94")	500(19.69")	
539-866 / AT715-3000	3000(120")	3040(119.68")	3178(125.12")	3162 (124.49")	3198(125.91")	529(20.83")	521(20.51")	530(20.87")	

*1: Signal cable length is the combination of signal code and extension cable (2m).

AT103, Standard-size Type



Order No. and mounting dimensions

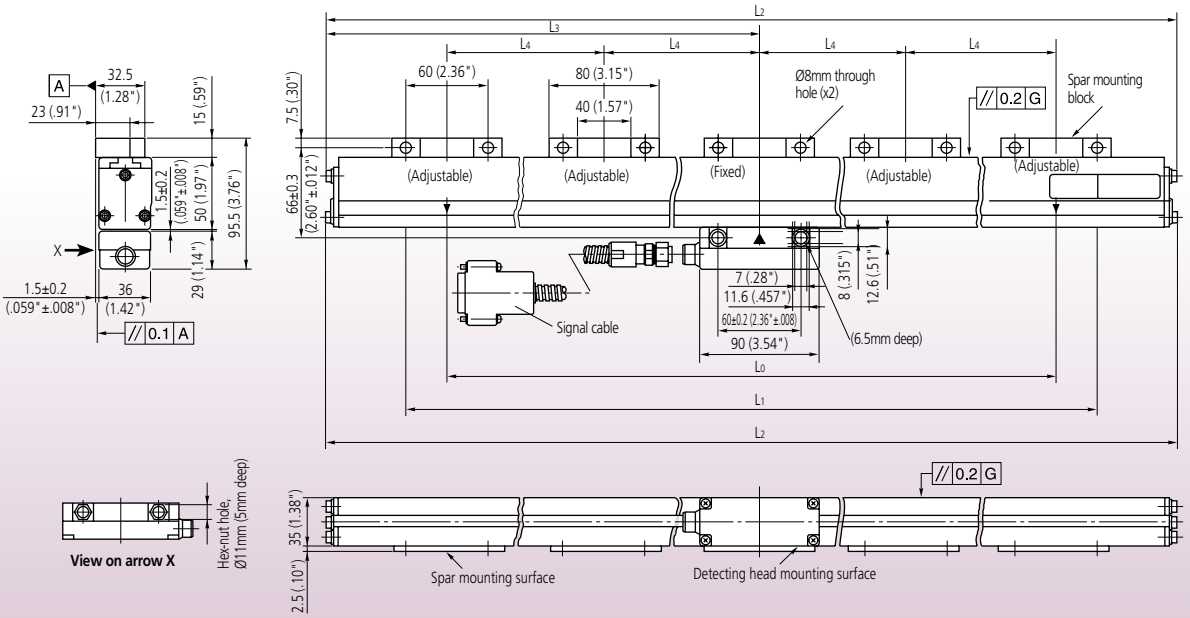
mm (inch)

Order No. / Model No. ( ): suffix for high accuracy type	Effective range L_0	Travel range L_1	Mount interval L_2	Overall length L_3	Supporting bracket position L_4	L_5	L_6	Signal cable length	Mass kg (lbs.)
539-111-30 (-40) / AT103-100 (F)	100 (4")	120 (4.72")	248 (9.76")	268 (10.55")	—	—	—	3m (9.8 feet)	1.5 (3.30)
539-112-30 (-40) / AT103-150 (F)	150 (6")	170 (6.69")	298 (11.73")	318 (12.52")	—	—	—	3m (9.8 feet)	1.6 (3.52)
539-113-30 (-40) / AT103-200 (F)	200 (8")	220 (8.66")	348 (13.70")	368 (14.49")	—	—	—	3m (9.8 feet)	1.7 (3.74)
539-114-30 (-40) / AT103-250 (F)	250 (10")	270 (10.63")	398 (15.67")	418 (16.46")	—	—	—	3m (9.8 feet)	1.8 (3.96)
539-115-30 (-40) / AT103-300 (F)	300 (12")	330 (12.99")	458 (18.03")	478 (18.82")	—	—	—	3m (9.8 feet)	1.9 (4.18)
539-116-30 (-40) / AT103-350 (F)	350 (14")	380 (14.96")	508 (20.00")	528 (20.79")	—	—	—	3m (9.8 feet)	2.0 (4.40)
539-117-30 (-40) / AT103-400 (F)	400 (16")	430 (16.93")	558 (21.97")	578 (22.76")	—	—	—	3m (9.8 feet)	2.1 (4.62)
539-118-30 (-40) / AT103-450 (F)	450 (18")	480 (18.90")	608 (23.94")	628 (24.72")	—	—	—	3m (9.8 feet)	2.2 (4.84)
539-119-30 (-40) / AT103-500 (F)	500 (20")	540 (21.26")	668 (26.30")	688 (27.09")	—	—	—	3m (9.8 feet)	2.3 (5.06)
539-121-30 (-40) / AT103-600 (F)	600 (24")	650 (25.59")	778 (30.63")	798 (31.42")	—	—	—	3m (9.8 feet)	2.6 (5.72)
539-123-30 (-40) / AT103-700 (F)	700 (28")	760 (29.92")	888 (34.96")	908 (35.75")	—	—	—	3m (9.8 feet)	2.8 (6.16)
539-124-30 (-40) / AT103-750 (F)	750 (30")	810 (31.89")	938 (36.93")	958 (37.72")	—	—	—	3m (9.8 feet)	2.9 (6.38)
539-125-30 (-40) / AT103-800 (F)	800 (32")	860 (33.86")	988 (38.90")	1008 (39.69")	—	—	—	3m (9.8 feet)	3.0 (6.60)
539-126-30 (-40) / AT103-900 (F)	900 (36")	960 (37.79")	1088 (42.83")	1108 (43.62")	—	—	—	3m (9.8 feet)	3.3 (7.26)
539-127-30 (-40) / AT103-1000 (F)	1000 (40")	1060 (41.73")	1188 (46.77")	1208 (47.56")	594 (23.39")	—	—	5m (16.4 feet)	3.7 (8.14)
539-128-30 (-40) / AT103-1100 (F)	1100 (44")	1160 (45.67")	1288 (50.71")	1308 (51.50")	644 (25.35")	—	—	5m (16.4 feet)	4.0 (8.80)
539-129-30 (-40) / AT103-1200 (F)	1200 (48")	1260 (49.60")	1388 (54.65")	1408 (55.43")	694 (27.32")	—	—	5m (16.4 feet)	4.2 (9.24)
539-130-30 (-40) / AT103-1300 (F)	1300 (52")	1360 (53.54")	1488 (58.58")	1508 (59.37")	744 (29.29")	—	—	5m (16.4 feet)	4.4 (9.68)
539-131-30 (-40) / AT103-1400 (F)	1400 (56")	1460 (57.48")	1588 (62.52")	1608 (63.31")	794 (31.26")	—	—	5m (16.4 feet)	4.6 (10.12)
539-132-30 (-40) / AT103-1500 (F)	1500 (60")	1560 (61.41")	1688 (66.46")	1708 (67.24")	844 (33.23")	—	—	5m (16.4 feet)	4.8 (10.56)
539-133-30 (-40) / AT103-1600 (F)	1600 (64")	1690 (66.53")	1818 (71.57")	1838 (72.36")	—	610 (24.02")	—	5m (16.4 feet)	5.1 (11.22)
539-134-30 (-40) / AT103-1700 (F)	1700 (68")	1790 (70.47")	1918 (75.51")	1938 (76.30")	—	650 (25.59")	—	5m (16.4 feet)	5.3 (11.66)
539-135-30 (-40) / AT103-1800 (F)	1800 (72")	1890 (74.41")	2018 (79.45")	2038 (80.24")	—	670 (26.38")	—	5m (16.4 feet)	5.5 (12.10)
539-136-30 (-40) / AT103-2000 (F)	2000 (80")	2100 (82.67")	2228 (87.72")	2248 (88.50")	—	740 (29.13")	—	5m (16.4 feet)	6.0 (13.20)
539-137-30 / AT103-2200	2200 (88")	2300 (90.55")	2428 (95.59")	2448 (96.38")	—	800 (31.50")	—	5m (16.4 feet)	6.4 (14.08)
539-138-30 / AT103-2400	2400 (96")	2500 (98.42")	2628 (103.46")	2648 (104.25")	1314 (51.73")	1300 (51.18")	650 (25.59")	7m (22.9 feet)	7.1 (15.62)
539-139-30 / AT103-2500	2500 (100")	2600 (102.36")	2728 (107.40")	2748 (108.19")	1364 (53.70")	1340 (52.76")	670 (25.38")	7m (22.9 feet)	7.3 (16.06)
539-140-30 / AT103-2600	2600 (104")	2700 (106.30")	2828 (111.34")	2848 (112.13")	1414 (55.67")	1400 (55.12")	700 (27.56")	7m (22.9 feet)	7.5 (16.50)
539-141-30 / AT103-2800	2800 (112")	2900 (114.17")	3028 (119.21")	3048 (120.00")	1514 (59.60")	1500 (59.06")	750 (29.53")	7m (22.9 feet)	7.9 (17.38)
539-142-30 / AT103-3000	3000 (120")	3100 (118.11")	3228 (127.09")	3248 (127.87")	1614 (63.99")	1600 (62.99")	800 (31.50")	7m (22.9 feet)	8.3 (18.26)

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Mitutoyo

Scale Unit



Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective range L_0	Travel range L_1	Overall length L_2	Supporting bracket position L_3	L_4	Signal cable length	Mass kg (lbs.)
539-143-30 / AT103-3250	3250 (130")	3350 (131.88")	3464 (136.38")	1725 (67.91")	800 (31.50")	10m (32.8 feet)	10.8 (23.76)
539-144-30 / AT103-3500	3500 (140")	3600 (141.73")	3714 (146.22")	1850 (72.83")	850 (33.46")	10m (32.8 feet)	11.4 (25.08)
539-145-30 / AT103-3750	3750 (150")	3850 (151.57")	3964 (156.06")	1975 (77.76")	930 (36.61")	10m (32.8 feet)	12.0 (26.40)
539-146-30 / AT103-4000	4000 (160")	4100 (161.42")	4214 (165.91")	2100 (82.68")	1000 (39.37")	10m (32.8 feet)	12.6 (27.72)
539-147-30 / AT103-4250	4250 (170")	4350 (171.26")	4464 (175.75")	2225 (87.60")	1050 (41.34")	10m (32.8 feet)	13.2 (29.04)
539-148-30 / AT103-4500	4500 (180")	4600 (181.10")	4714 (185.59")	2350 (92.52")	1100 (43.31")	10m (32.8 feet)	13.8 (30.36)
539-149-30 / AT103-4750	4750 (190")	4850 (191.94")	4964 (195.43")	2475 (97.44")	800 (31.50")	15m (49.2 feet)	15.2 (33.44)
539-150-30 / AT103-5000	5000 (200")	5100 (200.78")	5214 (205.28")	2600 (102.36")	830 (32.68")	15m (49.2 feet)	15.8 (34.76)
539-151-30 / AT103-5250	5250 (210")	5350 (210.63")	5464 (215.12")	2725 (107.28")	870 (34.25")	15m (49.2 feet)	16.4 (36.08)
539-152-30 / AT103-5500	5500 (220")	5600 (220.47")	5714 (224.96")	2850 (112.20")	910 (35.83")	15m (49.2 feet)	17.0 (37.40)
539-153-30 / AT103-5750	5750 (230")	5850 (230.31")	5964 (234.80")	2975 (117.13")	950 (37.40")	15m (49.2 feet)	17.6 (38.72)
539-154-30 / AT103-6000	6000 (240")	6100 (240.16")	6214 (244.65")	3100 (122.05")	1000 (39.37")	15m (49.2 feet)	18.2 (40.04)

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Mounting parts (provided as standard)

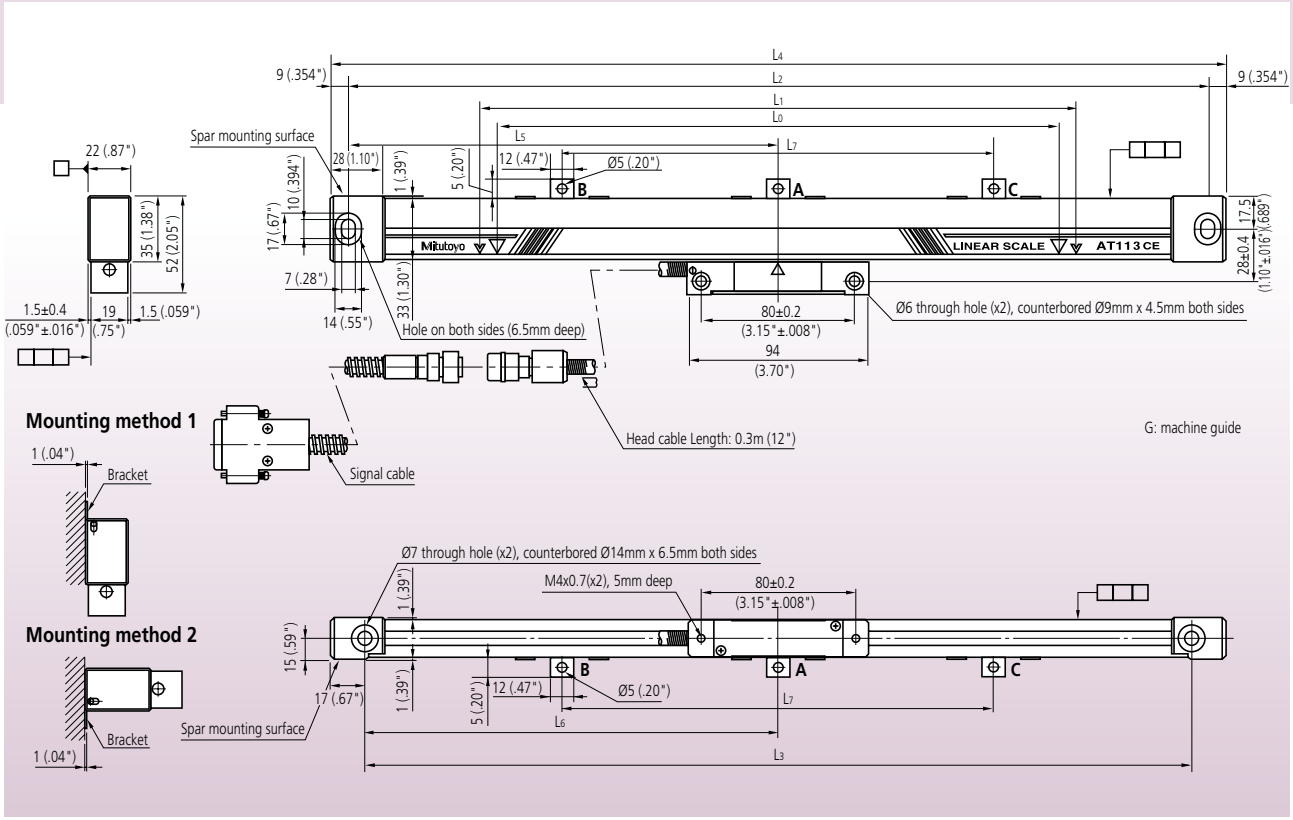
Type of spar	Standard-size		Extra-long	
Effective range L_0	100mm (4") - 3000mm (120")		3250mm (130") - 6000mm (240")	
Items included	• Hex-socket head screw (M6x1x40)	2 pcs.	• Hex-socket head screw (M6x1x40)	2 pcs.
	• Hex-socket head screw (M6x1x16)	2 pcs.	• Hex-socket head screw (M6x1x30)	14 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.	• Hex-socket head screw (M4x0.7x8)	7 pcs.
	• Spring washer (6mm nominal)	2 pcs.	• Spring washer (6mm nominal)	14 pcs.
	• Plain washer (6mm nomina)	2 pcs.	• Plain washer (6mm nomina)	14 pcs.
	• Cable clip	5 pcs.	• Cable clip	7 pcs.
	• Spacer (0.3mm)	1 pc.	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.	• Spacer (0.6mm)	1 pc.

Remarks: Dust-proofing and splash-proofing of the AT103 model scale units can be improved by supplying clean and dry air to the main spar.
(Air pressure required: 50kPa, Air flow rate: 10 to 20 normal liters per minute)

Extension cable

Order No.	Cable length
09AAA033A	2m (6.5 feet)
09AAA033B	5m (16.4 feet)
09AAA033C	7m (22.9 feet)

AT113, Slim Type



Order No. and mounting dimensions

mm (inch)

Order No. / Model No. ( ): suffix for high accuracy type	Effective range L_0	Travel range L_1	Mount interval L_2	Mount interval L_3	Overall length L_4	Supporting bracket position L_5	Supporting bracket position L_6	Supporting bracket position L_7	Signal cable length	Mass kg (lbs.)
539-201-30 (-40) / AT113-100 (F)	100 (4")	120 (4.72")	258 (10.16")	242 (9.53")	276 (10.87")	—	—	—	3m (9.8 feet)	0.9 (1.98)
539-202-30 (-40) / AT113-150 (F)	150 (6")	170 (6.69")	308 (12.13")	292 (11.50")	326 (12.83")	—	—	—	3m (9.8 feet)	0.9 (1.98)
539-203-30 (-40) / AT113-200 (F)	200 (8")	220 (8.66")	358 (14.09")	342 (13.46")	376 (14.80")	—	—	—	3m (9.8 feet)	0.9 (1.98)
539-204-30 (-40) / AT113-250 (F)	250 (10")	270 (10.63")	408 (16.06")	392 (15.43")	426 (16.77")	—	—	—	3m (9.8 feet)	1.0 (2.2)
539-205-30 (-40) / AT113-300 (F)	300 (12")	330 (12.99")	468 (18.43")	452 (17.80")	486 (19.13")	—	—	—	3m (9.8 feet)	1.0 (2.2)
539-206-30 (-40) / AT113-350 (F)	350 (14")	380 (14.96")	518 (20.39")	502 (19.76")	536 (21.10")	—	—	—	3m (9.8 feet)	1.1 (2.42)
539-207-30 (-40) / AT113-400 (F)	400 (16")	430 (16.93")	568 (22.36")	552 (21.73")	586 (23.07")	—	—	—	3m (9.8 feet)	1.1 (2.42)
539-208-30 (-40) / AT113-450 (F)	450 (18")	480 (18.90")	618 (24.33")	602 (23.70")	636 (25.04")	—	—	—	3m (9.8 feet)	1.1 (2.42)
539-209-30 (-40) / AT113-500 (F)	500 (20")	540 (21.26")	678 (26.69")	662 (26.06")	696 (27.40")	339 (13.35")	331 (13.03")	—	3m (9.8 feet)	1.2 (2.64)
539-211-30 (-40) / AT113-600 (F)	600 (24")	640 (25.20")	778 (30.63")	762 (30.00")	796 (31.34")	389 (15.31")	381 (15.00")	—	3m (9.8 feet)	1.3 (2.86)
539-213-30 (-40) / AT113-700 (F)	700 (28")	740 (29.13")	878 (34.57")	862 (33.94")	896 (35.28")	439 (17.28")	431 (16.97")	—	3m (9.8 feet)	1.3 (2.86)
539-214-30 (-40) / AT113-750 (F)	750 (30")	780 (30.71")	918 (36.14")	902 (35.51")	936 (36.85")	459 (18.07")	451 (17.76")	—	3m (9.8 feet)	1.4 (3.08)
539-215-30 (-40) / AT113-800 (F)	800 (32")	840 (33.07")	978 (38.50")	962 (37.87")	996 (39.21")	489 (19.25")	481 (18.94")	—	3m (9.8 feet)	1.4 (3.08)
539-216-30 (-40) / AT113-900 (F)	900 (36")	940 (37.01")	1078 (42.44")	1062 (41.81")	1096 (43.15")	539 (21.22")	531 (20.91")	—	3m (9.8 feet)	1.5 (3.3)
539-217-30 (-40) / AT113-1000 (F)	1000 (40")	1040 (40.94")	1178 (46.38")	1162 (45.75")	1196 (47.09")	589 (23.19")	581 (22.87")	—	5m (16.4 feet)	1.9 (4.18)
539-218-30 (-40) / AT113-1100 (F)	1100 (44")	1140 (44.88")	1278 (50.31")	1262 (49.69")	1296 (51.02")	—	—	430 (16.93")	5m (16.4 feet)	1.9 (4.18)
539-219-30 (-40) / AT113-1200 (F)	1200 (48")	1240 (48.82")	1378 (54.25")	1362 (53.62")	1396 (54.96")	—	—	460 (18.11")	5m (16.4 feet)	2.0 (4.4)
539-220-30 (-40) / AT113-1300 (F)	1300 (52")	1340 (52.76")	1478 (58.19")	1462 (57.56")	1496 (58.90")	—	—	490 (19.29")	5m (16.4 feet)	2.1 (4.62)
539-221-30 (-40) / AT113-1400 (F)	1400 (56")	1440 (56.69")	1578 (62.13")	1562 (61.50")	1596 (62.83")	—	—	530 (20.87")	5m (16.4 feet)	2.2 (4.84)
539-222-30 (-40) / AT113-1500 (F)	1500 (60")	1540 (60.63")	1678 (66.06")	1662 (65.43")	1696 (66.77")	—	—	560 (22.05")	5m (16.4 feet)	2.2 (4.84)

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Extension cable

Order No.	Cable length
09AAA033A	2m (6.5 feet)
09AAA033B	5m (16.4 feet)
09AAA033C	7m (22.9 feet)

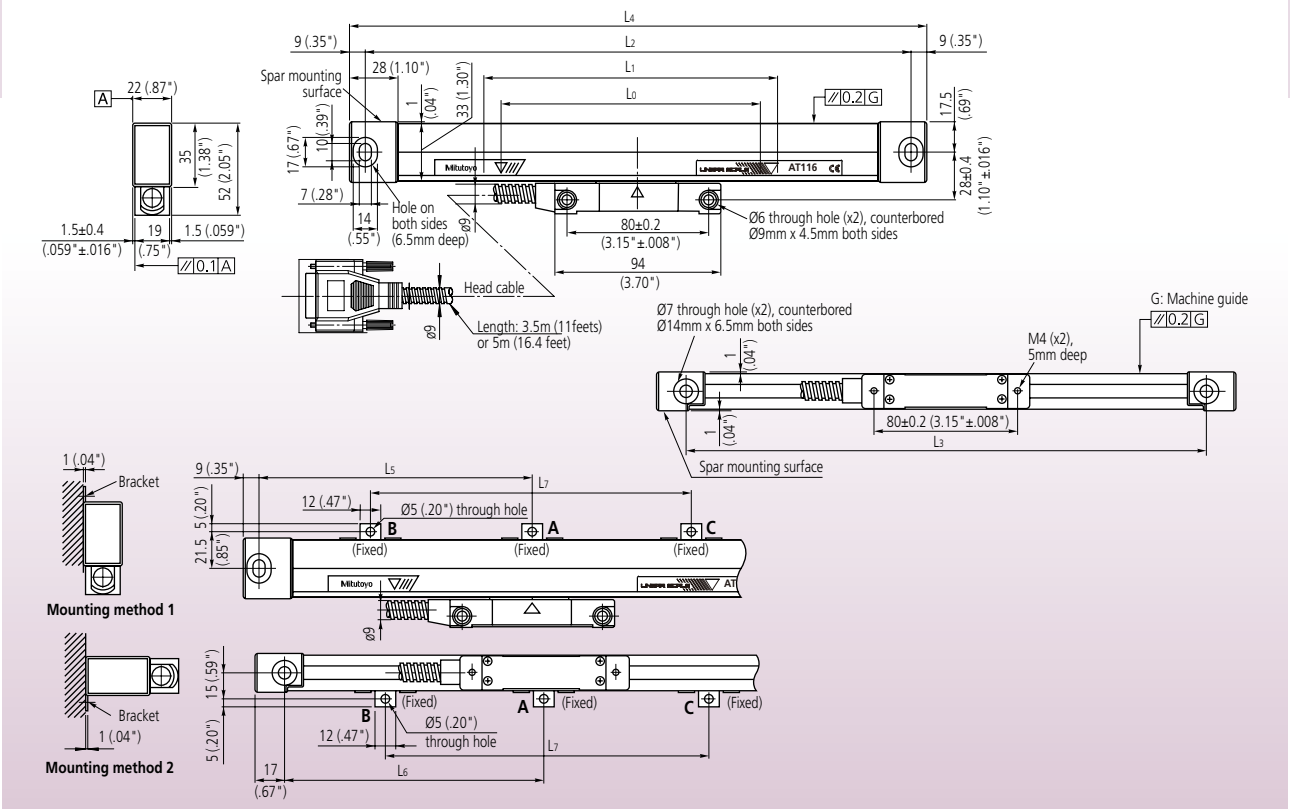
Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M6x1x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Spring washer (4mm nominal)	2 pcs.
	• Plain washer (4mm nomina)	2 pcs.
	• Cable clip	5 pcs.
	• Connector clamp	1 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

Mitutoyo

AT116, Slim and Economy Type

Scale Unit



Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective range L_0	Travel range L_1	Mount interval L_2	Mount interval L_3	Overall length L_4	Supporting bracket position L_5	L_6	L_7	Head cable length	Mass kg (lbs.)
539-271-30 / AT-116-100	100 (4")	120 (4.72")	258 (10.16")	242 (9.53")	276 (10.87")	—	—	—	3.5m (9.8 feet)	0.5 (1.1)
539-272-30 / AT-116-150	150 (6")	170 (6.69")	308 (12.13")	292 (11.50")	326 (12.83")	—	—	—	3.5m (9.8 feet)	0.6 (1.32)
539-273-30 / AT-116-200	200 (8")	220 (8.66")	358 (14.09")	342 (13.46")	376 (14.80")	—	—	—	3.5m (9.8 feet)	0.7 (1.54)
539-274-30 / AT-116-250	250 (10")	270 (10.63")	408 (16.06")	392 (15.43")	426 (16.77")	—	—	—	3.5m (9.8 feet)	0.8 (1.76)
539-275-30 / AT-116-300	300 (12")	330 (12.99")	468 (18.43")	452 (17.80")	486 (19.13")	—	—	—	3.5m (9.8 feet)	0.9 (1.98)
539-276-30 / AT-116-350	350 (14")	380 (14.96")	518 (20.39")	502 (19.76")	536 (21.10")	—	—	—	3.5m (9.8 feet)	1.0 (2.2)
539-277-30 / AT-116-400	400 (16")	430 (16.93")	568 (22.36")	552 (21.73")	586 (23.07")	—	—	—	3.5m (9.8 feet)	1.1 (2.42)
539-278-30 / AT-116-450	450 (18")	480 (18.90")	618 (24.33")	602 (23.70")	636 (25.04")	—	—	—	3.5m (9.8 feet)	1.2 (2.64)
539-279-30 / AT-116-500	500 (20")	540 (21.26")	678 (26.69")	662 (26.06")	696 (27.40")	339 (13.35")	331 (13.03")	—	3.5m (9.8 feet)	1.3 (2.86)
539-281-30 / AT-116-600	600 (24")	640 (25.20")	778 (30.63")	762 (30.00")	796 (31.34")	389 (15.31")	381 (15.00")	—	3.5m (9.8 feet)	1.4 (3.08)
539-283-30 / AT-116-700	700 (28")	740 (29.13")	878 (34.57")	862 (33.94")	896 (35.28")	439 (17.28")	431 (16.97")	—	3.5m (9.8 feet)	1.6 (3.52)
539-284-30 / AT-116-750	750 (30")	780 (30.71")	918 (36.14")	902 (35.51")	936 (36.85")	459 (18.07")	451 (17.76")	—	3.5m (9.8 feet)	1.7 (3.74)
539-285-30 / AT-116-800	800 (32")	840 (33.07")	978 (38.50")	962 (37.87")	996 (39.21")	489 (19.25")	481 (18.94")	—	3.5m (9.8 feet)	1.8 (3.96)
539-286-30 / AT-116-900	900 (36")	940 (37.01")	1078 (42.44")	1062 (41.81")	1096 (43.15")	539 (21.22")	531 (20.91")	—	3.5m (9.8 feet)	2.0 (4.4)
539-287-30 / AT-116-1000	1000 (40")	1040 (40.94")	1178 (46.38")	1162 (45.75")	1196 (47.09")	589 (23.19")	581 (22.87")	—	5m (16.4 feet)	2.3 (5.06)
539-288-30 / AT-116-1100	1100 (44")	1140 (44.88")	1278 (50.31")	1262 (49.69")	1296 (51.02")	—	—	430 (16.93")	5m (16.4 feet)	2.5 (5.5)
539-289-30 / AT-116-1200	1200 (48")	1240 (48.82")	1378 (54.25")	1362 (53.62")	1396 (54.96")	—	—	460 (18.11")	5m (16.4 feet)	2.7 (5.94)
539-290-30 / AT-116-1300	1300 (52")	1340 (52.76")	1478 (58.19")	1462 (57.56")	1496 (58.90")	—	—	490 (19.29")	5m (16.4 feet)	2.9 (6.38)
539-291-30 / AT-116-1400	1400 (56")	1440 (56.69")	1578 (62.13")	1562 (61.50")	1596 (62.83")	—	—	530 (20.87")	5m (16.4 feet)	3.1 (6.82)
539-292-30 / AT-116-1500	1500 (60")	1540 (60.63")	1678 (66.06")	1662 (65.43")	1696 (66.77")	—	—	560 (22.05")	5m (16.4 feet)	3.2 (7.04)

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

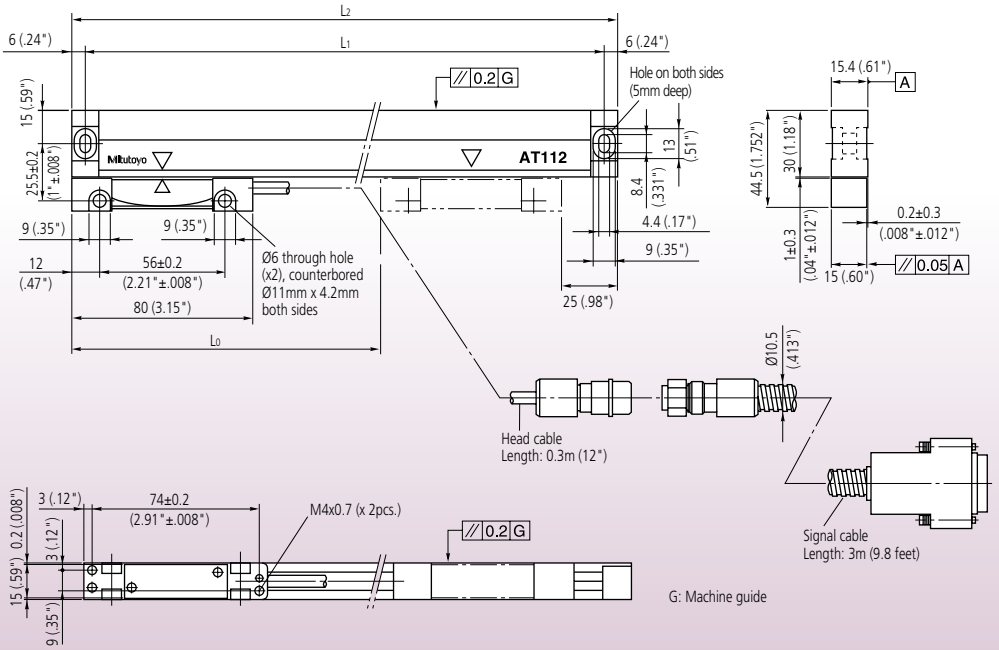
Extension cable

Order No.	Cable length
09AAA720A	2m (6.5 feet)
09AAA720B	5m (16.4 feet)
09AAA720C	7m (22.9 feet)

Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M6x1x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x25)	2 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Plain washer (6mm nominal)	2 pcs.
	• Plain washer (4mm nomina)	2 pcs.
	• Connector clamp	6 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

AT112-F, Super Slim Type



Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective range L_0	Mount interval L_1	Overall length L_2	Signal cable length	Mass kg (lbs.)
539-251-10 / AT112-50F	50 (2.0")	143 (5.63")	155 (6.10")	3m (9.8 feet)	0.72 (1.58)
539-252-10 / AT112-70F	70 (2.8")	163 (6.42")	175 (10.89")	3m (9.8 feet)	0.74 (1.63)
539-253-10 / AT112-120F	120 (4.8")	213 (8.39")	225 (8.86")	3m (9.8 feet)	0.80 (1.76)
539-254-10 / AT112-170F	170 (6.8")	263 (10.35")	275 (10.83")	3m (9.8 feet)	0.85 (1.87)
539-255-10 / AT112-220F	220 (8.8")	313 (12.32")	325 (12.80")	3m (9.8 feet)	0.90 (1.98)
539-256-10 / AT112-270F	270 (10.8")	363 (14.29")	375 (14.76")	3m (9.8 feet)	0.95 (2.09)
539-257-10 / AT112-320F	320 (12.8")	413 (16.26")	425 (16.73")	3m (9.8 feet)	1.00 (2.20)
539-258-10 / AT112-370F	370 (14.8")	463 (18.23")	475 (18.70")	3m (9.8 feet)	1.05 (2.31)
539-259-10 / AT112-420F	420 (16.8")	513 (20.20")	525 (20.67")	3m (9.8 feet)	1.10 (2.42)
539-260-10 / AT112-470F	470 (18.8")	563 (22.17")	575 (22.64")	3m (9.8 feet)	1.15 (2.53)
539-261-10 / AT112-520F	520 (20.8")	613 (24.13")	625 (24.61")	3m (9.8 feet)	1.20 (2.64)
539-262-10 / AT112-570F	570 (22.8")	663 (26.10")	675 (26.57")	3m (9.8 feet)	1.25 (2.75)
539-263-10 / AT112-620F	620 (24.8")	713 (28.07")	725 (28.54")	3m (9.8 feet)	1.30 (2.86)
539-264-10 / AT112-670F	670 (26.8")	763 (30.04")	775 (30.51")	3m (9.8 feet)	1.35 (2.97)
539-265-10 / AT112-720F	720 (28.8")	813 (32.01")	825 (32.48")	3m (9.8 feet)	1.40 (3.08)
539-266-10 / AT112-770F	770 (30.8")	863 (33.98")	875 (34.45")	3m (9.8 feet)	1.45 (3.19)
539-267-10 / AT112-820F	820 (32.8")	913 (35.94")	925 (36.42")	3m (9.8 feet)	1.50 (3.30)
539-268-10 / AT112-920F	920 (36.8")	1013 (39.88")	1025 (40.35")	3m (9.8 feet)	1.56 (3.43)
539-269-10 / AT112-1020F	1020 (40.8")	1113 (43.82")	1125 (44.29")	3m (9.8 feet)	1.62 (3.56)

Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Extension cable

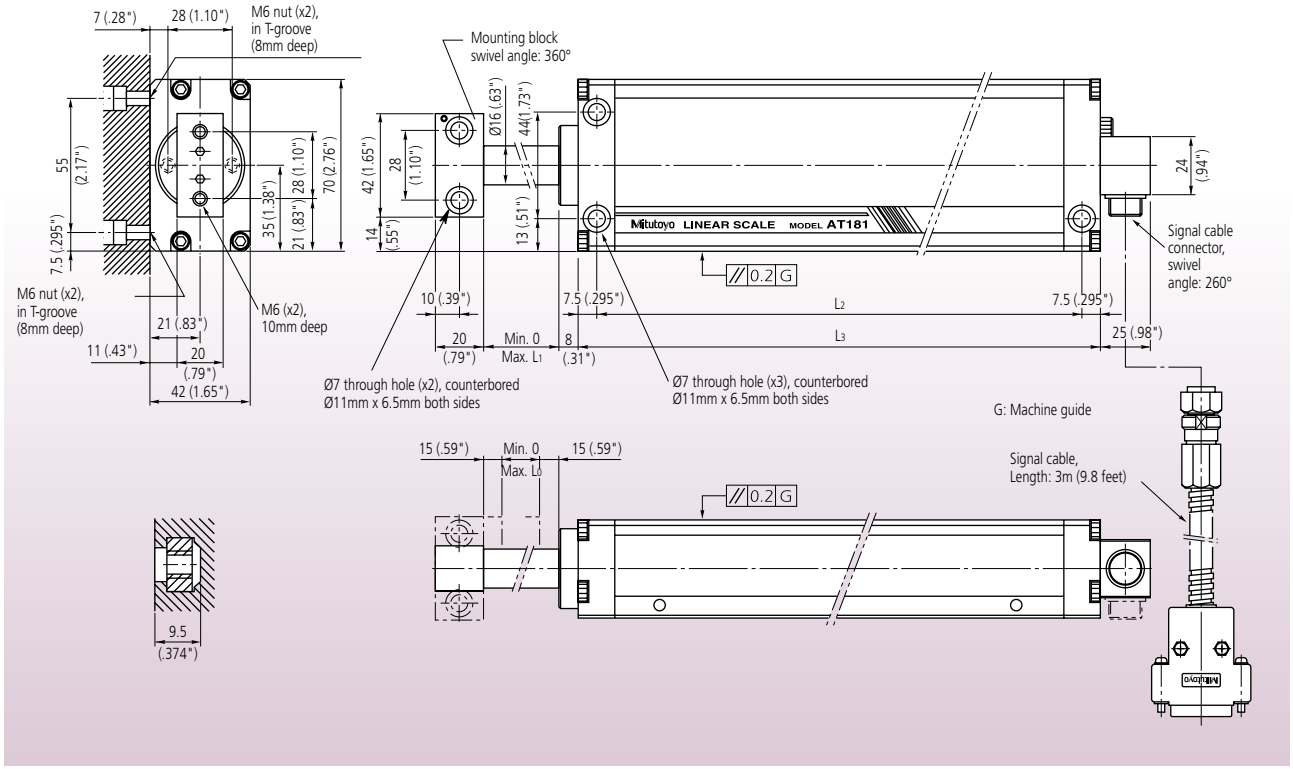
Order No.	Cable length
09AAA033A	2m (6.5 feet)
09AAA033B	5m (16.4 feet)
09AAA033C	7m (22.9 feet)

Mounting parts (provided as standard)

Items included	• Hex-socket head screw (M4x0.7x25)	4 pcs.
	• Hex-socket head screw (M4x0.7x8)	6 pcs.
	• Spring washer (4mm nominal)	4 pcs.
	• Plain washer (4mm nomina)	4 pcs.
	• Cable clip	5 pcs.
	• Connector clamp	1 pc.
	• Spacer (0.3mm)	1 pc.
	• Spacer (0.4mm)	1 pc.
	• Spacer (0.5mm)	1 pc.
	• Spacer (0.6mm)	1 pc.

Mitutoyo

AT181, Plunger Type



Order No. and mounting dimensions

mm (inch)

Order No. / Model No.	Effective range L_0	Travel range L_1	Mount interval L_2	Main spar length L_3	Signal cable length	Mass kg (lbs.)
539-301 / AT181-100	100 (4")	130 (5.11")	255 (10.04")	270 (10.63")	3m (9.8 feet)	1.7 (3.74)
539-302 / AT181-150	150 (6")	180 (7.08")	305 (12.01")	320 (12.60")	3m (9.8 feet)	1.9 (4.18)
539-303 / AT181-200	200 (8")	230 (9.05")	355 (13.98")	370 (14.57")	3m (9.8 feet)	2.1 (4.62)
539-304 / AT181-250	250 (10")	280 (11.02")	405 (15.94")	420 (16.54")	3m (9.8 feet)	2.3 (5.06)
539-305 / AT181-300	300 (12")	330 (12.99")	455 (17.91")	470 (18.50")	3m (9.8 feet)	2.5 (5.50)
539-306 / AT181-350	350 (14")	380 (14.96")	505 (19.88")	520 (20.47")	3m (9.8 feet)	2.7 (5.94)
539-307 / AT181-400	400 (16")	430 (16.93")	555 (21.85")	570 (22.44")	3m (9.8 feet)	2.9 (6.38)
539-308 / AT181-450	450 (18")	480 (18.90")	605 (23.82")	620 (24.41")	3m (9.8 feet)	3.1 (6.82)
539-309 / AT181-500	500 (20")	530 (20.87")	655 (25.79")	670 (26.38")	3m (9.8 feet)	3.3 (7.26)
539-310 / AT181-550	550 (22")	580 (22.83")	705 (27.76")	720 (28.35")	3m (9.8 feet)	3.5 (7.70)
539-311 / AT181-600	600 (24")	630 (24.83")	755 (29.72")	770 (30.31")	3m (9.8 feet)	3.7 (8.14)

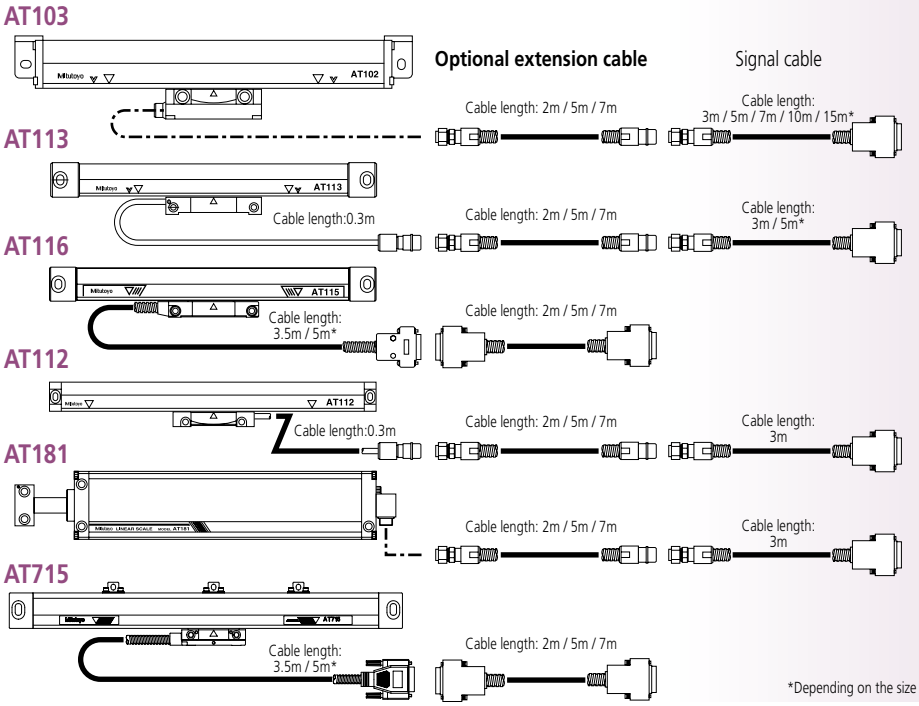
Note) When selecting the size of a scale unit for your application, make sure that the maximum travel range of the scale unit (L_1) is larger than the maximum travel range of the machine. Also, take into consideration in selecting a size that the accuracy of the scale unit is guaranteed only within the range of the effective measuring length (L_0).

Extension cable

Order No.	Cable length
09AAA033A	2m (6.5 feet)
09AAA033B	5m (16.4 feet)
09AAA033C	7m (22.9 feet)

Scale Unit Features

When using an optional extension cable

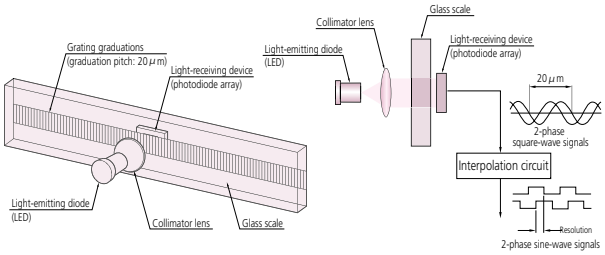


*Depending on the size of scale unit

KA counter, standard type

KLD-200 counter, with limit signal output

Operating Principle of AT103/AT113 Models



The assembly-type Linear Scale® uses a highly accurate glass scale grating pitch of 20 µm as the basic standard of length. The grating is irradiated with parallel light generated with a Light-Emitting Diode (LED) and collimator lens. The parallel light transmitted through the grating generates an interference pattern with the same pitch as that of a grating on the photodiode array of the light-receiving device. The receiver output signal is 2-phase sinusoidal with a wavelength of 20µm, identical to the pitch of the grating graduations, and is electrically converted to 2-phase square-wave signals by the interpolation circuit. The much smaller working resolution is achieved by detecting the cyclic variation in light intensity incident on the receiver array, as the scale is displaced in a measuring direction, and interpolating accordingly to output a corresponding displacement value.

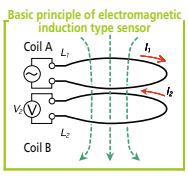
Detecting Principle Added to AT715

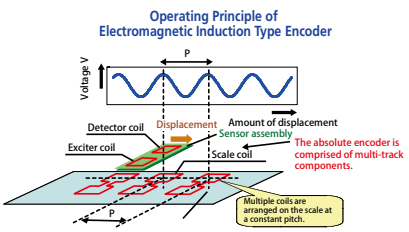
The Absolute system-type linear scale AT715 employs a unique, Mitutoyo-proprietary, electromagnetic induction principle that is highly resistant to environmental contamination.
Achievement of a complete absolute scale with a resolution of 1µm thanks, to a multi-track configuration, enables the user to obtain absolute positional information from the scale immediately power is applied to the counter.

- If time-varying current I1 is applied to coil A, a magnetic flux is generated inside the coil.
- A current I2 is induced in coil B that tends to oppose the build-up of the magnetic flux.

The magnetic permeability between the coils will not vary whether the medium is air, water, or oil.

The electromagnetic induction type sensor has excellent water resistance and oil resistance.





Mitutoyo

Display Unit Selection Guide

Functions

Function \ Counter		KA Counter	KLD-200 Counter
Zero-setting	ZERO	●	●
Preset	P.SET	●	●
Resolution setting	0.0005 / 0.1	●	●
Measurement direction setting		●	●
mm/inch conversion	mm / E	●	●
Diameter display	DIA	●	●
Scale reference point setting[-1]	SET	●	●
1/2 calculation	1/2	●	●
Coordinate system switching	N	●	—
Bolt-hole circle machining		●[-2]	—
Pitch machining		●	—
Zero approach machining (INC mode)		●	—
Addition of 2-scale data	Z1+Z2	●[-3]	—
Linearity error compensation		●	●
Smoothing	1234	●	●
Memory backup		●	●
Expansion/contraction coefficient setting		—	●
Lower digit blanking out	123	●	●
External zero-setting	ZERO SET IN PUT	▲[-4]	●
RS-232C interface unit	RS-232C OUTPUT	▲	●
Limit signal output	LIMIT OUTPUT	—	●
Error message	Error	●	●
Memorization of machining reference point for each cutting tool[-5]	TOOL	●	—

●: Standard function, ▲: Optional function, —: Not available

-1: Not available when connecting with AT715
-2: Not available in single axis use
-3: Only available for 3-axis model
-4: RS-232C interface unit (**09CAB217**) is required.
-5: for KA counter

KA Counter

FEATURES

- Can be used as a "standard counter" or a "lathe counter" by modifying parameters.
- Downsizing and weight saving have been realized.
- Sub display is employed: the selected datum number can be recognized at a glance.
- The optional external interface RS-232C enables connection to a PC and a printer.

174-173 (for 1-axis or 2-axis application)

174-175 (for 3-axis application)

SPECIFICATIONS

Order No.	174-173*	174-175*
Scale input ports	2	3

*To denote your AC line voltage add the following suffixes to the order No. (e.g.: **174-173A**): **A** for UL/CSA, **D** for CEE, **E** for BS, **DC** for China, **K** for EK, **No suffix** is required for JIS/100V

Technical Data: Common

Scale input ports: 2, 3
Resolution: 0.001mm, 0.005mm, .0001", .0005" (selectable)
Display: 7-digit LED and a negative [-] sign
Power supply: 100V-240V AC, 50/60Hz
Mass: 1.25kg (**174-173**), 1.33kg (**174-175**)

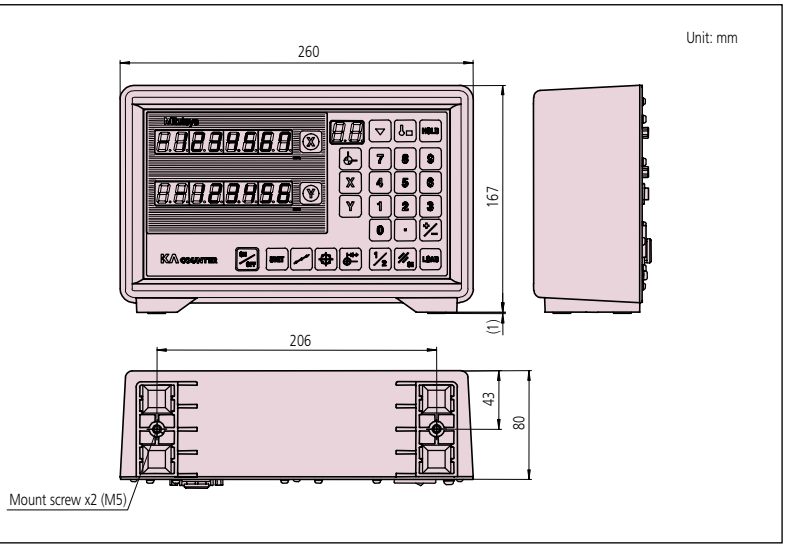
Standard Accessories

02ZAA000: 1.8m AC cable (Japan)
02ZAA010: 1.8m AC cable (USA, Canada)
02ZAA020: 1.8m AC cable (Europe)
02ZAA030: 1.8m AC cable (UK)
02ZAA040: 1.8m AC cable (China)
02ZAA050: 1.8m AC cable (Korea)
09CAA958: Dust-proof cover
936626: GND lead wire (4m)
ZERO key seal set
PRESET key seal set
User's Manual: 1 set

Optional Accessories

09CAB217: RS-232C interface unit (with D-Sub 25-pin / 9-pin connectors)
06ACF941: External extension cable

DIMENSIONS



Mitutoyo

KLD-200 Counter

Display Unit

FEATURES

- A 1-axis counter dedicated to sending signals when a linear scale displacement value and a preset limit value coincide.
- Two types of limit settings are available: 2 step and 4 step.
- For controlling the vertical position of an EDM or grinding machine head.
- Can be connected to a personal computer or a sequencer via an RS-232C interface or limit signal output (standard feature)

174-146 (2-step model)

174-147 (4-step model)

SPECIFICATIONS

Order No.	174-146	174-147
Limit signal output	2-step	4-step
Limit value setting method	Digital switch	Digital switch

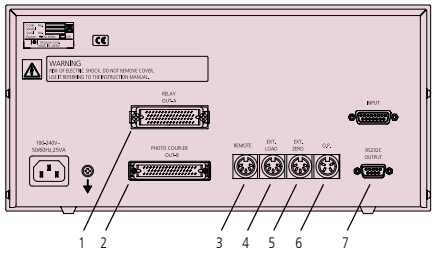
*To denote your AC line voltage add the following suffixes to the order No. (e.g.: **174-146A**): **A** for UL/CSA, **D** for CEE, **E** for BS, **DC** for China, **K** for EK, **No suffix** is required for JIS/100V

Standard Accessories

02ZAA000: 1.8m AC cable (Japan)
02ZAA010: 1.8m AC cable (USA, Canada)
02ZAA020: 1.8m AC cable (Europe)
02ZAA030: 1.8m AC cable (UK)
02ZAA040: 1.8m AC cable (China)
02ZAA050: 1.8m AC cable (Korea)
936626: GND lead wire (4m)
09ABZ456: Dust-proof cover
I/O output connector: 2 pcs
Mounting bracket: 1 set
User's Manual: 1 set

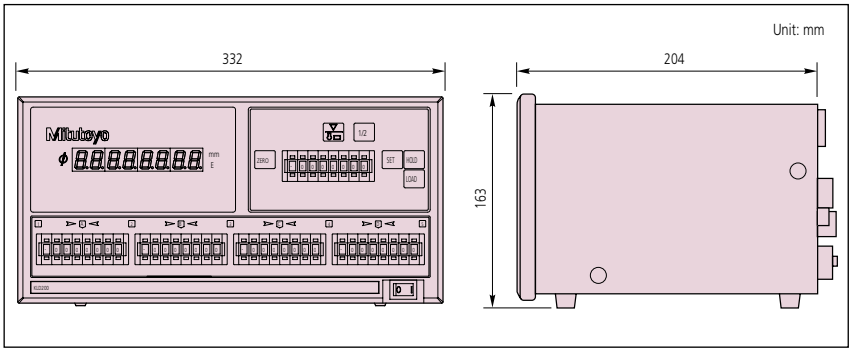
Technical Data: Common

Limit signal output: 2-step, 4-step
Scale input ports: 1
Resolution: 0.0005mm, 0.001mm, 0.002mm, 0.005mm. 0.01mm .00002", .00005", .0001", .0002", .0005", .001"
Display: 9-digit LED and a negative [-] sign
Limit value setting method: Digital switch
Power supply: 100-120V/200-240V AC, 50/60Hz
Mass: 4.5kg



1: Relay signal output
2: Photocoupler signal output
3: Remote signal input
4: External load signal input
5: External zero-set signal input
6: Touch signal input
7: RS-232C interface
8: Relay signal output

DIMENSIONS



Display Unit Functions

BASIC FUNCTIONS

ZERO Zero-setting

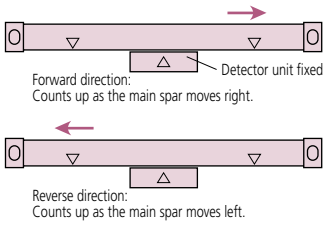
The display can be set to "0" (zero) at any scale position.

0.001 / 0.01 Resolution setting

The most suitable resolution can be selected to meet measuring applications. Available resolutions depend upon the counter to be used.

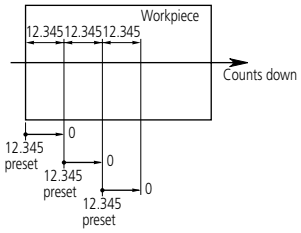
Measurement direction setting

The measurement direction can be selected.


Detector unit fixed
Forward direction:
Counts up as the main spar moves right.
Reverse direction:
Counts up as the main spar moves left.

P.SET Preset

This function allows the user to enter a numeric value on the counter display. Any preset value can be retrieved whenever necessary.



1/2 1/2 calculation

This function halves the display value.

mm/E mm/inch conversion

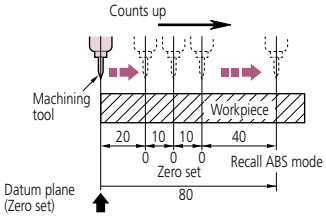
The counting unit can be changed between "mm" and "inch" (or between "mm" and "E (=1/25.4mm)" depending on the model.)

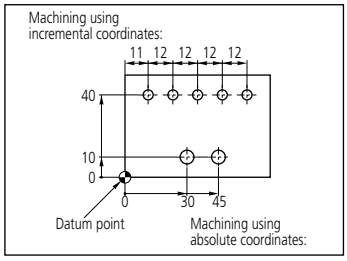
123 Lower digit blanking out

Unnecessary lower digits (up to 9 digits of the lowest digits) can be blanked out.

Absolute/incremental coordinate system switching

For each axis, the measured value can be obtained in either absolute (ABS) or incremental (INC) coordinates. This function is useful, for example, if the following operation is performed. Set the datum point for a workpiece in the absolute mode. Then, after performing zero setting, presetting, etc., in the incremental mode, return to the absolute mode. In this way the absolute distance from the datum point can be easily displayed.

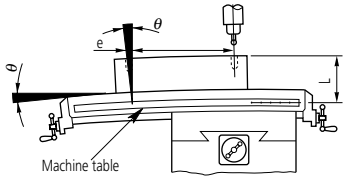




SPECIAL FUNCTIONS

Linearity error compensation

Machine errors caused due to workpiece weight, inaccurate table adjustment, etc., are linearly compensated to reduce the positioning error.



1234 Smoothing

Smoothing makes the display value easier to read when the least significant digits fluctuate due to machine vibration.

Memory backup

The backup battery ensures the most recent display value is retained even when the counter is off.

Expansion/contraction coefficient setting

This function multiplies the actual counter measurements by a constant factor. This is useful in, for example, mold manufacture by allowing the mold to be machined to the actual molded component dimensions directly, without having to increase the machining dimensions manually to allow for material shrinkage after molding. Tedious work can thus be reduced and the risk of mistakes in calculation eliminated.

A CLR Parameter All Clear

Clears the setup parameter data and resets to the default data.

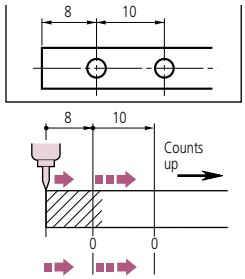
Mitutoyo

Display Unit

MILLING MACHINE FUNCTIONS

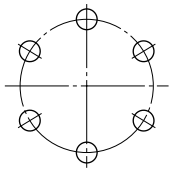
Zero approach machining [INC mode]

Zero approach machining can be repeated at preset intervals. Since the counter keeps the total displacement in absolute coordinates, a positioning error made by the operator at one tooling position has no effect on the remaining positions.



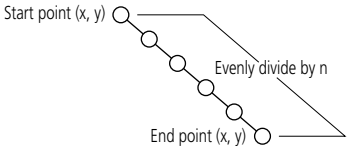
Bolt-hole circle machining

In milling, the drilling positions along the circumference of the base circle in the absolute zero approach mode can be easily displayed by entering the center coordinates, diameter, and number of divisions of the base circle.



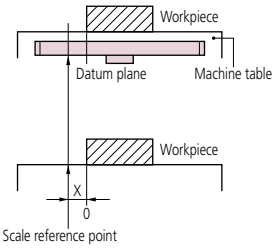
Pitch machining

Bores holes between two arbitrary points on the X-Y plane at equal spaces. By inputting the number of holes and positions of the start and end points, holes can be bored easily at equal spacing. Errors due to table positioning by the machine are automatically corrected to the next target value.



SET Scale reference point setting

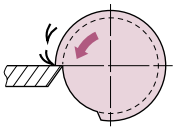
The linear scale has scale reference points at 50mm intervals. When one of the points is detected, the linear scale issues a signal to hold/restart counting. If the distance from a scale reference point to the machine origin is registered as the offset value, it will be retained even when the power is off (hold function). When the power is turned on, the machine origin or machining datum can be easily recalled (set function).



LATHE FUNCTIONS

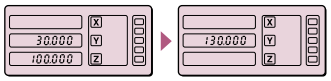
DIA Diameter display

The doubled scale displacement can be displayed. This convenient function can be used to display the diameter of a workpiece during a turning operation.



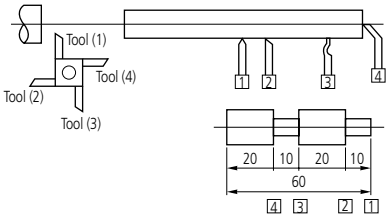
Z1+Z2 Addition of 2-scale data

The sum of the displayed values of two axes can be displayed. If a machine has two feed components, fine feed and coarse feed, each with its own scale, this function can be used to sum the two feed values.



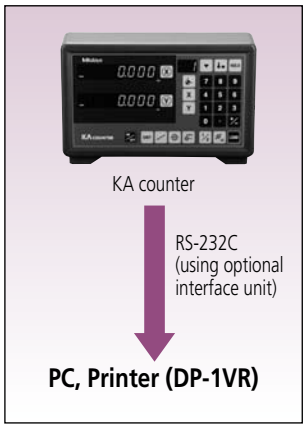
TOOL Memorization of machining reference point for each cutting tool (for KA counter)

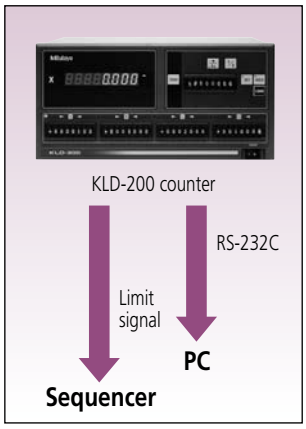
Absolute coordinate and incremental coordinate can be switched by every one of four cutting tools. The counter can memorize the center of a machining workpiece as a reference point and it can display the diameter of the machine workpiece by using absolute coordinate. The counter can zeroset/preset at the arbitrary position by using incremental coordinate.



Connecting to External Devices

Mitutoyo's DRO system accurately detects and displays the displacement of machine tool or measuring equipment slideways, and outputs the measurement data and limit signal to a peripheral device such as a PC or Sequencer through a built-in or optional interface.





RS-232C Interface

- The RS-232C interface unit enables measurement data output, as well as zero-setting, by commands from the computer.
- The RS-232 interface unit is standard equipment for the KLD-200 counter. The KA counter is available as an optional accessory.

DATA OUTPUT MODE

Trigger Mode (KLD-200 counter):
Measurement data can be output by signals from a touch-signal probe or commands from a computer.

Interval Mode (KA counter and KLD-200 counter):
Measurement data can be output at specific intervals.

SPECIFICATIONS

- Communication specifications

Home position	DCE
Communication method	Half-duplex, nonprocedural
Data transfer speed (Baud rate)	300, 600, 1200, 2400, 4800, 9600, 19200bps
Bit configuration	Start bit: 1 Data bit*: 7 or 8 Parity bit: 1 (even, odd), 0 (none) Stop bit: 1
Condition setting	Can be set using the respective parameters. (*dip switch setting for KA counter)

- Operation for data output
  Counter display values can be output in the following ways. Only one signal type can be used for input at any one time.

Method	Counter mode	Output axis	Applicable counters
Data request command X CR LF Y CR LF Z CR LF A CR LF	Normal mode	X-axis Y-axis Z-axis All axes	KA, KLD-200
External extension cable and external load box	Normal mode	Axes that are selected by the external load box	KA
External extension cable and foot switch	Normal mode	All axes	KA
EXT.LOAD signal input or external load box	Nomal mode	All axes	KLD-200

The KA/KLD-200 counter can be controlled externally by executing the following commands through a computer, etc. Command codes must be entered in upper-case characters.

Function	Command code from PC
Zero-setting Sets the counter display values to zero.	RX CR LF: for X-axis RY CR LF*: for Y-axis RZ CR LF*: for Z-axis
Error cancelation Has the same effect as the CANCEL key on the counter.	CO CR LF

*Not available for KLD-200 counter.

- Error code output
  If a data output command is issued when the counter is in an error status, or when an incorrect command is issued, the counter outputs a corresponding error code signal.

Notes

When the counter displays "12345.678".

X		+	1	2	3	4	5	.	6	7	8	CR	LF

When the counter displays "0.000".

X		+	0	0	0	0	0	.	0	0	0	CR	LF

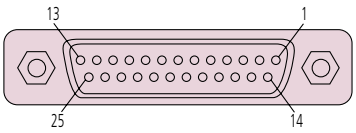
- The output data format is fixed to either 7 or 8 digits, without zero-suppression.
- If data is output from multiple axes, a comma "," is used as a delimiter. e.g. X +12345.678, Y +90123.456 CR LF
- Data is output in the same unit that is used on the counter (mm or inch). However, the unit identifier itself will not be output.

Mitutoyo

Data Output

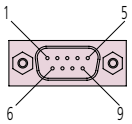
• RS-232C connector
Connector used: 9-pin and 25-pin (KA counter*)
25-pin (KLD-200 counter)

*The optional RS-232C Interface Unit for the KA counter is equipped with two connectors on the board.



Applicable plug (female)
• HDBB-25P (plug / HIROSE)
• HDB-CHT (case / HIROSE)

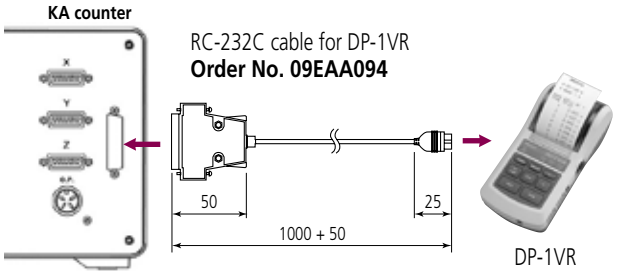
No. of pin	Signal	I/O	Remarks
1	FG	—	Frame grounding
2	SD	Input	Command
3	RD	Output	Data
4	—	—	Not used
5	CS	Output	Fixes to "Hight".
6	DR	Output	Fixes to "Hight".
7	SG	—	Signal grounding
8 to 12	—	—	Not used
13		Input	X-axis load
14		Input	Y-axis load
15		—	Not used
16		Input	Z-axis load
17 to 22		—	Not used
23		Input	X-axis zero-setting
24		Input	Y-axis zero-setting
25		Input	Z-axis zero-setting



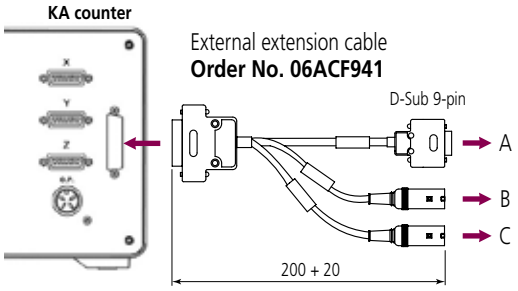
Applicable plug (female)
• HDEB-9S (plug / HIROSE)
• HDE-CHT (case / HIROSE)

No. of pin	Signal	I/O	Remarks
1	—	—	Not used
2	RD	Output	Data
3	SD	Input	Command
4	—	—	Not used
5	SG	—	Signal grounding
6	DR	Output	Fixes to "Hight".
7	—	—	Not used
8	CS	Output	Fixes to "Hight".
9	—	—	Not used

• Optional RS-232C Interface Unit for KA counter: **09CAB217**
The optional RS-232C interface unit enables measurement data output to a peripheral device such as a PC or DP-1VR, as well as zero-setting by commands from PC or the external zero-set box.



• External extension cable (KA Counter only). By attaching an external extension cable to a KA Counter + RS-232C code out unit, the optional external load box, foot switch and external zeroset box can be connected.
RS-232C outputs can be used together.



A: PC
B: External load box / Foot switch
C: External zero-set box

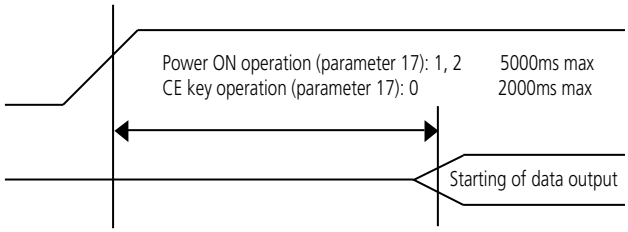
Unit: mm

Connecting to External Devices

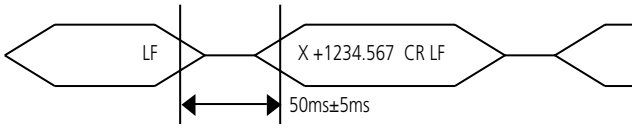
TIMING CHART

• Interval Mode (KA counter):
Measurement data can be output at specific intervals.

Data output timing on startup

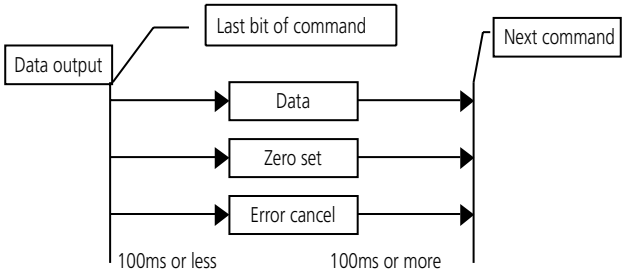


The display mode at startup can be selected with the parameter 17 (KA counter).



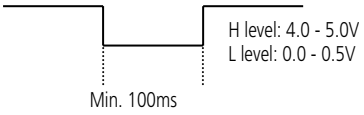
Data will be output with 50ms interval regardless of the transmission speed.

• Trigger Mode (KA counter and KLD-200 counter):
Measurement data can be output by commands from the computer.



Each value in the timing chart indicates response time to a command. Consequently, be aware that this command may cause a difference between a detected point and the actual one when the slider is moving.

• External zero signal (KA counter and KLD-200 counter)



Maintain the low level for 100ms or more.

Mitutoyo

Limit Signal Output

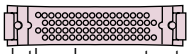
An interface that outputs signals to an external device when the measurement value from the Linear Scale is the same as the preset limit value. Can be used for GO/NG judgment and automatic control of a machine tool.

RELAY SIGNAL OUTPUT (OUT-A)

This connector is used to output relay signals. The limit signals will be output in the format of the relay's ON and OFF signals.

(1) Connector used

- MR-60RM (female)
  [Manufacturer: Honda Tsushin]



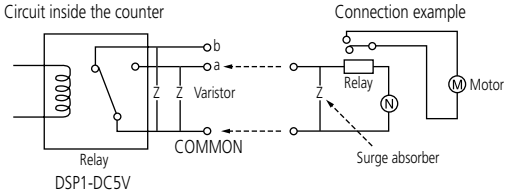
- When an error message is displayed, the alarm output will be set to ON. When this happens all relay outputs are set to ON.
- Limit signals are numbered to correspond with the number of limit steps existing, each using a corresponding set of pins: the 2-step type has up to 2 limit signals; the 4-step type has up to 4 limit signals; and the 8-step type has up to 8 limit signals. The other pins are not assigned.

Note: A connector plug (MR-60LF, Honda Tsushin) is provided as standard.

(2) Pin assignment (Example of a counter with 8 limit steps)

No. of pin	Signal	
1 - 3	Coincidence:	1= a contact, 2= common, 3= b contact
4 - 6	Alarm:	4= a contact, 5= common, 6= b contact
7 - 9	Limit signal 0:	7= a contact, 8= common, 9= b contact
10 - 12	Limit signal 1:	10= a contact, 11= common, 12= b contact
13 - 15	Limit signal 2:	13= a contact, 14= common, 15= b contact
16 - 18	Limit signal 3:	16= a contact, 17= common, 18= b contact
19 - 21	Limit signal 4:	19= a contact, 20= common, 21= b contact
22 - 60	Not connected	

Notes on the connection of relay signal output



Do not use the limit signal output through the relay of the KLD-200 Counter to directly control other devices such as motors. Always route the relay output through another relay at the external device side, as shown in the diagram above. Although the relay contact circuit of the counter is equipped with varistors (threshold voltage: 300V), it is advisable to provide a surge absorber on the external device to be connected, which may generate surge current. For example, a varistor is recommended for an AC circuit, and an appropriate diode is recommended for a DC circuit.

Capacity of relay contact inside the counter
5V - 30V AC, 10mA - 500mA
5V - 30V DC, 10mA - 500mA

The external control device should not cause the contact capacity, as stated above, to be exceeded.

Specifications

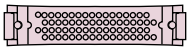
Connectable counter	KLD Counter
Number of output axes	1
Number of output steps	2 or 4
Output	Relay and photocoupler

PHOTOCOUPLER SIGNAL OUTPUT (OUT-B)

This connector is used to output photocoupler signals, which use the same logic as relay signals.

(1) Connector used

- MR-50RM (female)
  [Manufacturer: Honda Tsushin]



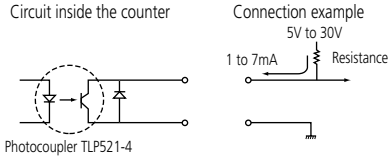
- When an error occurs, the alarm output will be set to ON.

Note: A connector plug (MR-50LF, Honda Tsushin) is provided as standard.

(2) Pin assignment (Example of a counter with 8 limit steps)

No. of pin	Signal	
1 - 2	Limit signal 0:	1= emitter, 2= collector
3 - 4	Limit signal 1:	3= emitter, 4= collector
5 - 6	Limit signal 2:	5= emitter, 6= collector
7 - 8	Limit signal 3:	7= emitter, 8= collector
9 - 10	Limit signal 4:	9= emitter, 10= collector
11 - 46	Not connected	
47 - 48	Coincidence:	47= emitter, 48= collector
49 - 50	Alarm:	49= emitter, 50= collector

Notes on the connection of photocoupler output

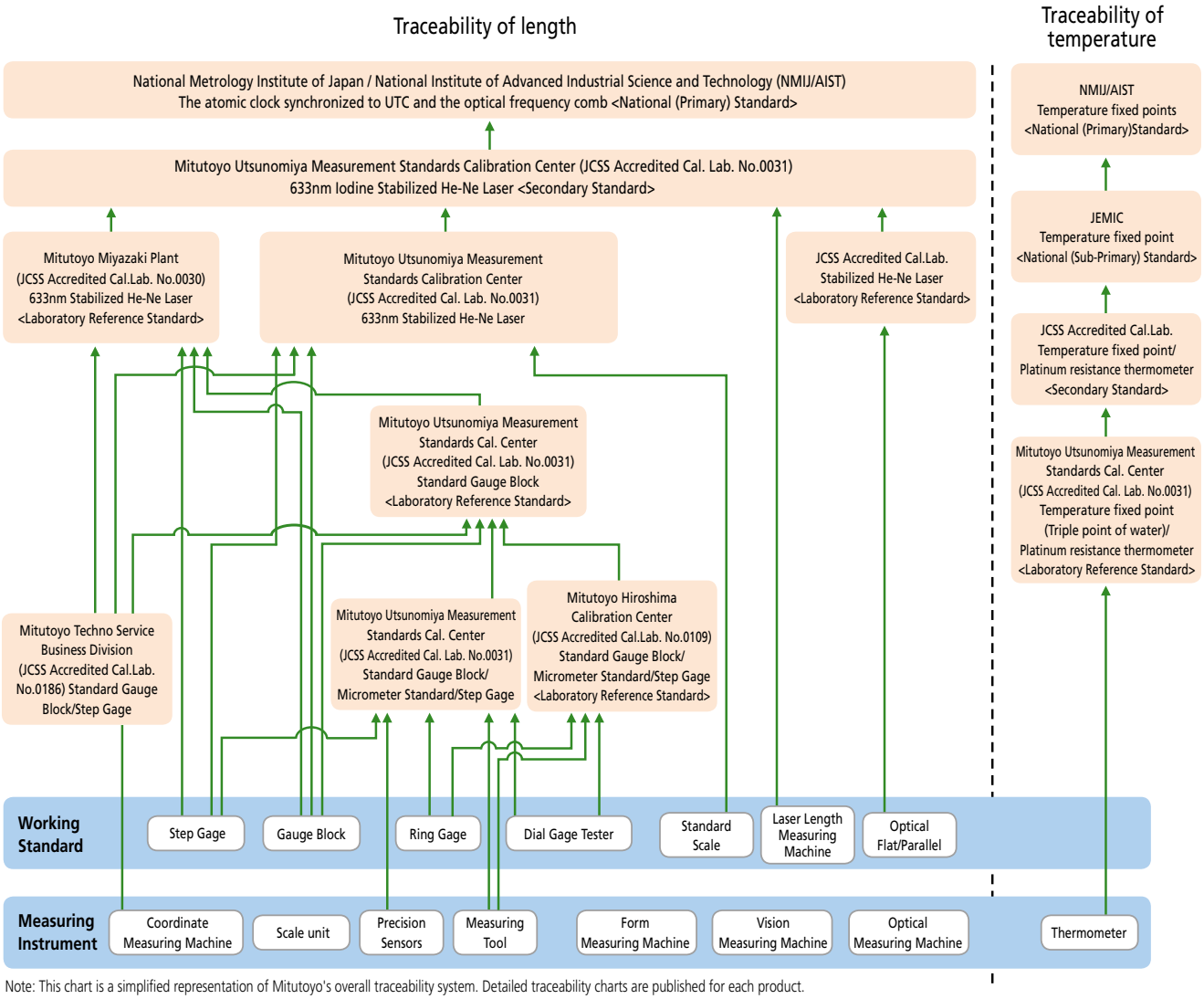


Recommended power supply to the transistor
5V - 30V, 1mA - 7mA

Traceability System

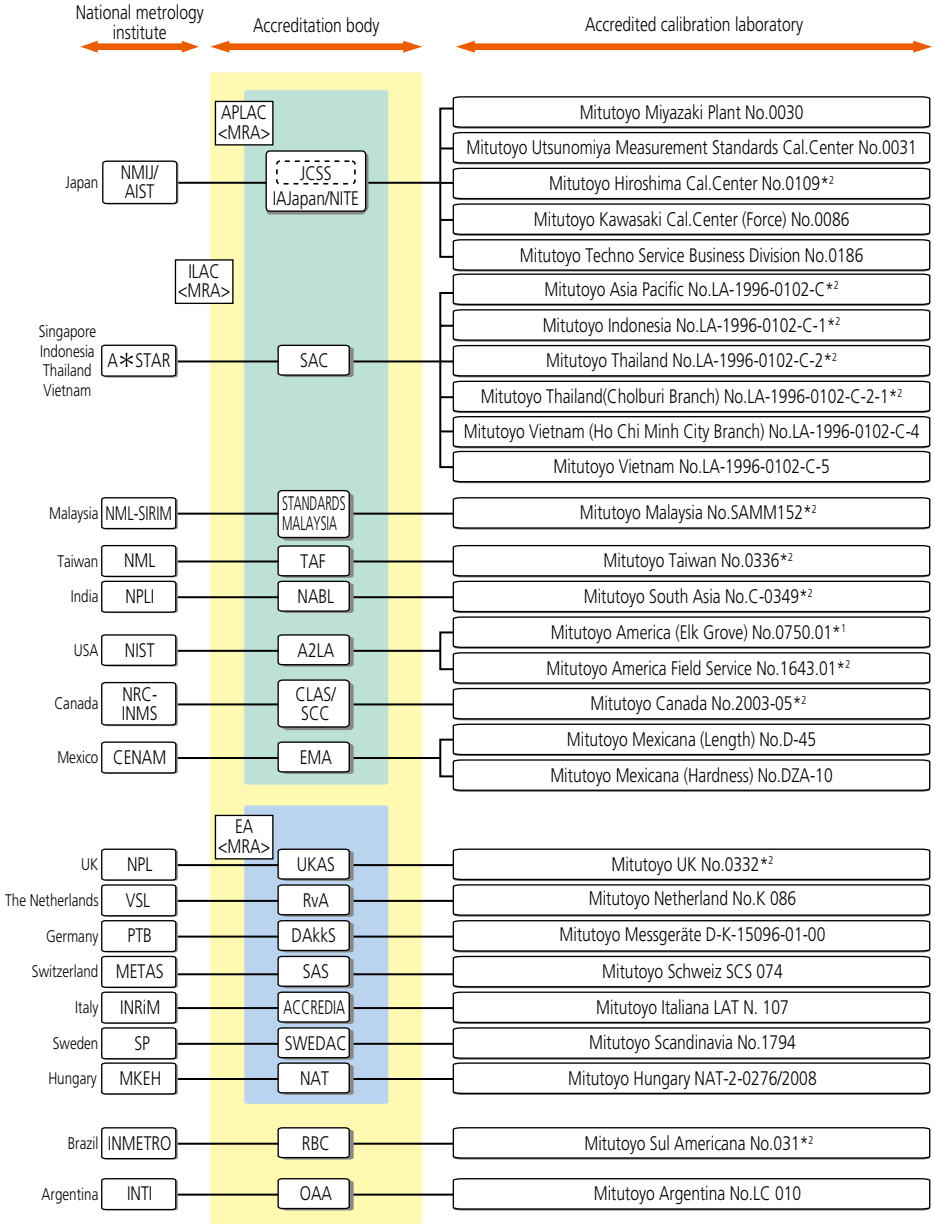
Mitutoyo has a traceability system made possible through an in-house calibration organization certified by the ISO/IEC 17025 international standard, with length standards directly related to the national standards (stabilized He-Ne laser) at the highest level. The stabilized He-Ne laser assures a performance equivalent to that of this national standard.

Further, the national standard is mutually recognized by CIPM, and the certified calibration organization is mutually recognized by ILAC, so that the establishment and maintenance of traceability for Mitutoyo products is achieved both in Japan and overseas.



Note: This chart is a simplified representation of Mitutoyo's overall traceability system. Detailed traceability charts are published for each product.

Calibration Laboratories Worldwide



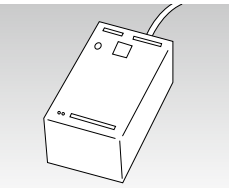
AIST: National Institute of Advanced Industrial Science and Technology
NMIJ: National Metrology Institute of Japan
JCSS: Japan Calibration Service System
NITE: National Institute of Technology and Evaluation
IAJapan: International Accreditation Japan
A STAR : Agency for Science, Technology and Research
SAC: Singapore Accreditation Council
NML: National Measurement Laboratory
TAF: Taiwan Accreditation Foundation
NML-SI RIM: National Metrology Laboratory, Standards and Industrial Research Institute of Malaysia
STANDARDS MALAYSIA: Department of Standards Malaysia
NIST: National Institute of Standards and Technology
A2LA: American Association for Laboratory Accreditation
NRC-INMS: National Research Council of Canada-Institute for National Measurement Standards
CLAS: Calibration Laboratory Assessment Service
SCC: Standards Council of Canada
CENAM: Centro Nacional de Metrologi´a
EMA: Entidad Mexicana de Acreditacio´n, a.c.
UKAS: United Kingdom Accreditation Service
NMi: Nederlands Meetinstituut
RvA: Raad voor Accreditatie
PTB: Physikalisch-Technische Bundesanstalt
DAkkS: Deutsche Akkreditierungsstelle GmbH
METAS: The Swiss Federal Office of Metrology and Accreditation
SAS: Swiss Accreditation Service
IMGC: Istituto di Metrologia " GUSTAVO COLONNETTI "
ACCREDIA: L'NTE ITALIANO DI ACCREDITAMENTO
SP: Swedish National Testing and Research Institute
SWEDAC: Swedish Board for Accreditation and Conformity Assessment
INMETRO: I nstituto Nacional de Metrologia Normalizacao e Qualidade Industrial
RBC: Rede Brasileira de Calibracao
INTI: Instituto Nacional de Tecnologia Industrial
OAA: Organismo Argentino de Acreditaci
NPL: National Physical Laboratory
NABL: National Accreditation Board for Testing and Calibration Laboratories
(ILAC): International Laboratory Accreditation Cooperation
(APLAC): Asia-Pacific Laboratory Accreditation Cooperation
(EA): European Accreditation Cooperation
(MRA): Mutual Recognition Arrangement
#: Accreditation No

The abovementioned accredited laboratories are authorised to calibrate with respect to length only unless marked as below:
*1 Authorised to calibrate with respect to Length and Temperature
*2 Authorised to calibrate with respect to Length and Hardness

Optional Accessories

External Load Box

Outputs counter value just by pressing the button when using the counter's data output function.
(For KA (equipped with RS-232C output) and KLD200 Counter.)

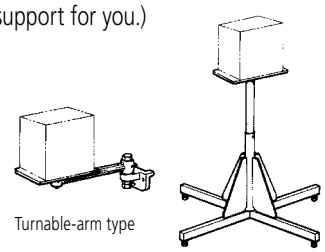


Part No.	Number of axis
937328	3-axis

Note 1: Both of the counter and the external zero-set box have to have the same number of axis.
Note 2: When using for KA Coutner, a cable for external connection is also required.

Counter Support

Holds on various counters. Desk-top, turnable-arm, turnable-double-arm, stand, and special type are available. (The support type depends on the counter. Please specify your counter so that we can select the appropriate support for you.)



Turnable-arm type

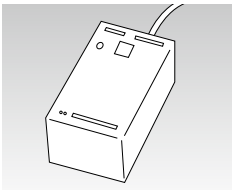
Digimatic Mini-Processor DP-1VR

Prints out the displayed data when connected with RS-232C output of KA Counter. For connection, use RS-232 counter cable (1m).
(For KA (RS-232C output) counter.)

Order No.	Product Name
264-504	DP-1VR
Part No.	Product Name
09EAA094	RS-232C counter cable

External Load Box

Outputs counter value just by pressing the button when using the counter's data output function.
(For KA (equipped with RS-232C output) and KLD200 Counter.)

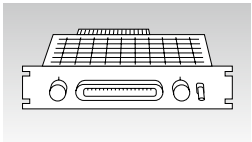


Part No.	Number of axis
936553	3-axis

Note 1: Both of the counter and the external zero-set box have to have the same number of axis.
Note 2: When using for KA Coutner, a cable for external connection is also required.

RS232C Code Out Unit

RS-232C unit to be mounted on the counter.
(For KA Counter)

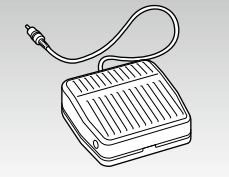


Part No.	Counter name
09CAB217	KA

Mitutoyo

External Load Foot Switch

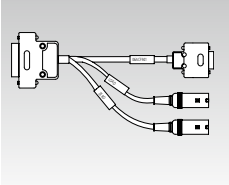
Outputs counter value just by stepping on the switch when using the counter's data output function. (For KA (equipped with RS-232C output) and KLD200 Counter.)



Note 1: When using for KA Coutner, a cable for external connection is also required.

Cable for External Connection

External zero-set box, external load box and external load foot switch can be used when connected with RS-232C output of KA Counter. Combination use with RS-232C output is available.



Part No.	06ACF941

Note 1: (Refer to Page-19 for details.)

Extension Cable

Extends the cable length of a Linear Scale when there is a distance between the Linear Scale and a counter.

For AT100 Series

Part No.	Cable length
09AAA033A	2m
09AAA033B	5m
09AAA033C	7m

For AT715

Part No.	Cable length
09AAB674A	2m
09AAB674B	5m
09AAB674C	7m

Various Adapters

Mitutoyo provides a variety of adapters, meeting various applications. (Refer to Pages 26 to 27 for details.)

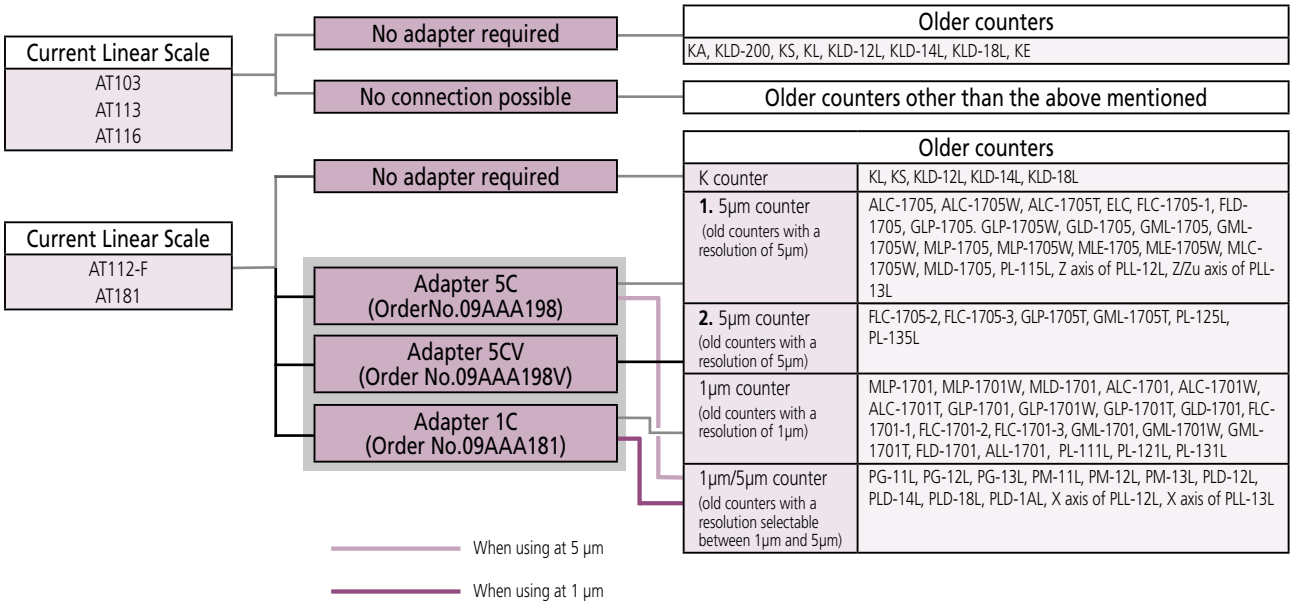
- Connecting adapters for former Linear Scales and existing counters (KA counter)
- Connecting adapters for existing Linear Scales (AT100 Series) and former counters.
- Adapters for limit signal output to connect with the limit signal output connector after replacing the former limit output counter with the existing KLD200 counter.
- Connecting adapters for line-driver-output Linear Scales, various sensors and existing counters (KA counter)

Optional Adapters

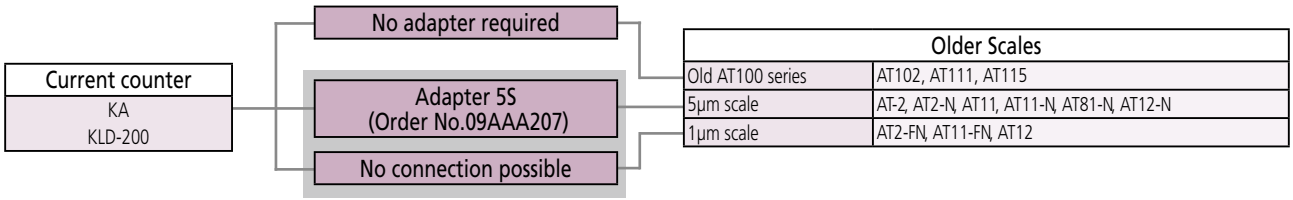
Adapters for Connecting between Older and Current Products

A specific adapter may be required for connecting between an older product and a current product. For applicable connecting adapters, refer to the following configuration diagrams. An adapter is connected to the input connector on a counter.
It is not possible to connect a 1µm scale (old linear scale) and current counter (KA, KLD200).
Also, linear scale AT715 and an older counter (other than KA and KLD200) cannot be connected.

Adapter configurations for connecting between a current linear scale (AT100 series) and an older counter


Current Linear Scale
AT103
AT113
AT116
No adapter required
No connection possible
Older counters
KA, KLD-200, KS, KL, KLD-12L, KLD-14L, KLD-18L, KE
Older counters other than the above mentioned
Current Linear Scale
AT112-F
AT181
No adapter required
Adapter 5C
(OrderNo.09AAA198)
Adapter 5CV
(Order No.09AAA198V)
Adapter 1C
(Order No.09AAA181)
Older counters
K counter
KL, KS, KLD-12L, KLD-14L, KLD-18L
1. 5µm counter
(old counters with a resolution of 5µm)
ALC-1705, ALC-1705W, ALC-1705T, ELC, FLC-1705-1, FLD-1705, GLP-1705. GLP-1705W, GLD-1705, GML-1705, GML-1705W, MLP-1705, MLP-1705W, MLE-1705, MLE-1705W, MLC-1705W, MLD-1705, PL-115L, Z axis of PLL-12L, Z/Zu axis of PLL-13L
2. 5µm counter
(old counters with a resolution of 5µm)
FLC-1705-2, FLC-1705-3, GLP-1705T, GML-1705T, PL-125L, PL-135L
1µm counter
(old counters with a resolution of 1µm)
MLP-1701, MLP-1701W, MLD-1701, ALC-1701, ALC-1701W, ALC-1701T, GLP-1701, GLP-1701W, GLP-1701T, GLD-1701, FLC-1701-1, FLC-1701-2, FLC-1701-3, GML-1701, GML-1701W, GML-1701T, FLD-1701, ALL-1701, PL-111L, PL-121L, PL-131L
1µm/5µm counter
(old counters with a resolution selectable between 1µm and 5µm)
PG-11L, PG-12L, PG-13L, PM-11L, PM-12L, PM-13L, PLD-12L, PLD-14L, PLD-18L, PLD-1AL, X axis of PLL-12L, X axis of PLL-13L
When using at 5 µm
When using at 1 µm

Adapter configurations for connecting between a current counter and an older linear scale



Limit Output Adapter

If an older limit output counter is replaced with a current counter, the limit output cable connected with the older counter is made available by relaying the limit output adapter.

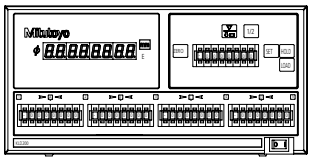
Connection compatibility table

Older counter model to be replaced	Succession model	Limit output adapter No.
MLD-1701N, MLD-1705N2	KLD-212	907872
MLD-1701N4, MLD-1705N4	KLD-214	
GLD-1701-2R, GLD-1705-2R	KLD-212	
GLD-1701-4R, GLD-1705-4R	KLD-214	
FLD-1701-2R, FLD-1705-2R	KLD-212	
PLD-12L	KLD-212	
PLD-14L	KLD-214	
KLD-12L, PLD-12L	KLD-212	No adapter required
KLD-14L, PLD-14L	KLD-214	

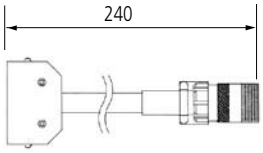
Note 1) Limit counters other than the above-mentioned are not compatible since there is no model with the same specification.

Note 2) The limit output adapter is dedicated to a relay output.
If any of the above counters uses a photocoupler output, the limit output cable must be remanufactured.

Adapter configuration of limit signal



KLD200 Counter



Limit signal cable used for the old counter

Line Conversion Adapter

Connects a line-driver-output Linear Scale, a Linear Gage and a KA counter.

Configuration of line-driver-output models and connecting adapters for the KA counter

Applicable Models

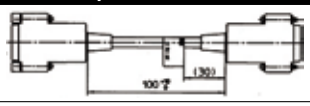
Square-wave-signal-output AT Scale
AT211, AT202, AT212

Square-wave-signal-output ST Scale
ST36B, ST36C, ST46B, ST46C, ST44B, ST44C, ST24B, ST24C, ST422, LH23C, LHS33C

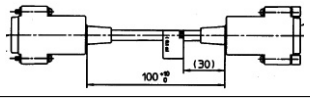
Linear Gage with origin point mark
LGF-ZL series

Standard type Linear Gage
LGF series, LGK series, LGB series, LG 100mm-stroke type, LGM 100mm-stroke type

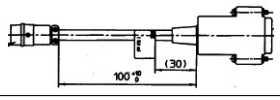
Adapter A: 06ACB391



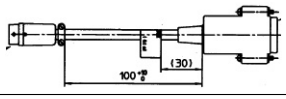
Adapter B: 06ACB392

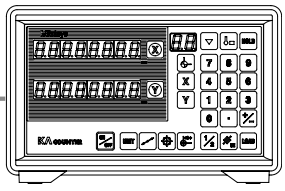


Adapter C: 06ACB393



Adapter D: 06ACB913





KA Counter

Note 1) For details regarding square-wave-signal-output scales and Linear Gages, refer to leaflet No. E4189 "NC Linear scale" and No. E4174 "LINEAR GAGE".

Note 2) Use an optional connecting cable for ST Series (2m/3m/5m), or make a connecting cable to the counter using a connector provided with a ST Scale as standard .
Other adapters than Adapter B can be directly connected to the counters.

CAUTION

When using adapters A to D, maximum response speed is determined by the resolution of the connected models.

When the parameter 96 of the KA counter is set to 5 (input frequency: 300kHz)

Connected model's resolution	Maximum response speed
1µm	300mm/s
0.5µm	150mm/s
0.2µm	60mm/s
0.1µm	30mm/s

Precautions when mounting and handling Linear Scales

Selecting the scale unit mounting position and mounting method

It is important to keep in mind the following four points when determining the scale unit mounting position and orientation.

Ease of mounting

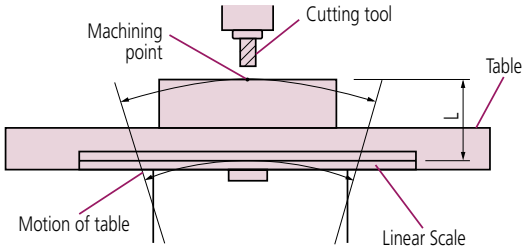
Mount the scale unit making sure that the unit including the detector head and the cables does not interfere with any part of the machine. To facilitate mounting, mount the scale unit and the brackets on machined surfaces wherever possible.

Protection from machining fluids and swarf (mounting orientation)

The scale unit is constructed in such a way that machining fluids and swarf cannot easily enter into the interior of the unit. However, since the openings are protected from entry of foreign material with rubber seals only, avoid directly exposing the scale unit to machining fluids and swarf. Select the mounting orientation of the scale unit after carefully considering the direction in which machining fluids and swarf are sprayed and scattered.

Accuracy considerations

The total system accuracy of the machine on which the scale unit is mounted is not only determined by the scale unit accuracy but by the machine accuracy as well. Particularly for machines with slide tables, geometrical errors may occur, depending on the straightness of moving parts; Thus, the scale unit must be mounted in a way that these errors are minimized. If the slide table moves not linearly but curvilinearly, errors occur in proportion to the distance "L" between the scale unit and the machining point (cutter position). Thus, mount the scale unit in a position that minimizes "L".



Other considerations

- If the detector head moves, the signal cables also move with the slide table. This should be considered when laying out the signal cables. It is therefore recommended to mount the scale unit on the moving part of the machine.
- Mount the scale unit in place where it is not directly subjected to airflow. When removing swarf using an air gun, be careful of flying swarf.
- The scale unit must be mounted in a place where maintenance can be easily performed in case unit trouble occurs.

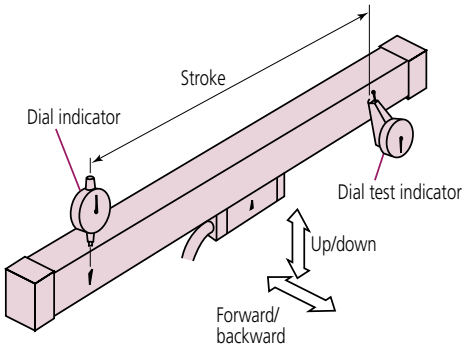
Checking parallelism and adjustment of scale unit

In order to attain maximum accuracy, the scale unit must be mounted parallel to the machine guide (machining axis). Incorrect mounting may cause the scale unit to bend or twist.

Checking parallelism

Use a dial indicator as shown in the figure below. To adjust the parallelism between the scale unit and the machine guide, check the parallelism while manually moving the machine's movable part such as the slide table, or measure the parallelism with reference to the guideways of the machine or equivalent reference surface.

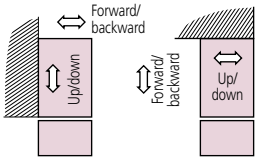
- Parallelism tolerance: Refer to each figure on dimensions.
- Checking direction: Back/forward direction on mounting surface and directions along mounting surface (up and down).
- Checking position: Position of scale unit around the mounting blocks.



Adjusting parallelism

Adjust the parallelism to within 0.2mm. Spacers used in adjustment are not included in the accessories.

- Adjusting the mounting surface back/forward: Readjust the mounting positions of the brackets or place spacers between the scale unit mounting surface and the mounting blocks.
- Adjusting along (up and down) the mounting surface: Adjust the parallelism by sliding the mounting block on the mounting surface.



Mitutoyo

Air pressurization improves environmental resistance

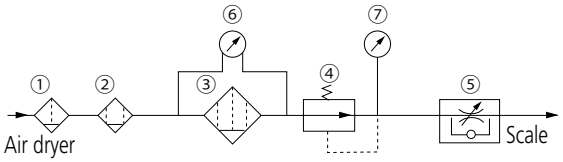
The resistance to dust and oil penetration of assembly-type linear scales can be improved by pressurizing the unit with clean air. Supply air into the pipe inserted in either screw holes (M5) on both sides of the scale unit.

* Of the linear scales described in this catalog, the AT103 series only supports air supply.

The method of supplying compressed air to the scale unit is provided as one means of improving the environmental resistance (resistance to coolant and dust) of linear scales.

Supply air observing the following specifications.

1. Air pressure supplied to the scale: 0.1MP (approx. 1kgf/cm^2)
   The air pressure supplied to the scale is to be that indicated by a pressure gage as shown in the diagram below at position ⑦.
   Adjust supplied air to the above pressure with the regulator.
2. Air flow rate: 10 to 20 l/min (per axis)
   (IMPORTANT: This flow rate is equivalent to the extent that air is slightly expelled from the slit aperture of the dust-proof rubber.
   Adjust supplied air to the above flow rate with the flow regulating valve.
3. Used air
   Do not supply air directly from the compressor, but always use compressed air after drying through an air dryer. Be sure to install an air filter, etc., based on the following diagram.



Air supply components

1	Air filter
2	Mist separator
3	Micro-mist separator
4	Regulator
5	Flow regulating valve
6	Differential pressure gage
7	Pressure gage

Note) Replace air filter ① and the elements of mist separator ② and micro-mist separator ③ once a year or if a change in pressure at differential pressure gage ⑥ reaches 0.1MP (approx. 1kg/cm^2).

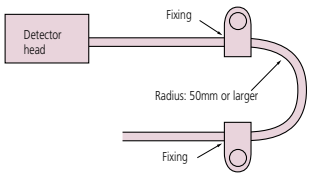
The air supply components listed in the table at left can be used to supply air to linear scales on 3 to 4 axes. If air is supplied to linear scales on multiple axes, attach flow regulating valve ⑤ directly to an air inlet on each scale (either M5 tapped holes on both sides of each scale).

Signal cable layout

It is important to keep in mind the following points when deciding on the layout scheme for signal cables.

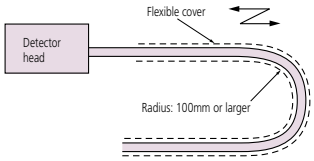
When the cable is fixed

The radius of curvature of the signal cable must be larger than 50mm.



When the cable is movable

When the detector head is the moving element, it carries the signal cable with it during operation. Take care, in such a cable, that the radius of curvature of the signal cable is not smaller than 100mm and excessive force is not applied to the cable. It is a good idea to protect the cable with a flexible support cover.



Note) It is important to ensure that the signal cable does not interfere with, and is not chafed by, any part of the machine.

Other considerations

The signal cable is durable enough to withstand repeated bending up to approximately 2 million times (when the bending radius is limited to more than 100mm). When repeated bending exceeding 2 million times is expected, the signal cable should be considered as a consumable part. In such a case, carrying a spare cable will allow immediate replacement when necessary and so minimize machine downtime.

Precautions when mounting and handling Linear Scales

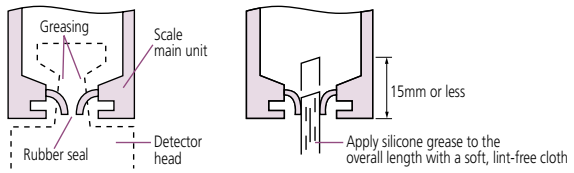
Resonance point of Linear Scale

Each object has a natural frequency, depending on its shape, length, and the type of material. The Linear Scale frame is not an exception. It has its natural frequency and thereby resonates at a certain frequency. In general, this will not cause a problem, since a machine tool and the Linear Scale frame have different natural frequencies under normal machining conditions. However, should the natural frequency of the machine tool body and the Linear Scale coincide, the following counter-measures can be taken:

1. Increase rigidity of the mounting bracket for the scale.
2. Add a mid-support to the middle of the scale to shift its resonance point higher.
3. Mount the Linear Scale at a place where vibrations from the machine tool cannot be easily transmitted.
4. Limit the machine process conditions to be within a specific range in which the natural frequencies of the machine tool and the scale do not coincide.

Maintenance of dust-proof seals

In order to maintain and extend the life of the dust-proof rubber seals, it is recommended that a small amount of silicon lubricant be applied to the contact area between the rubber and the detector head once a year.



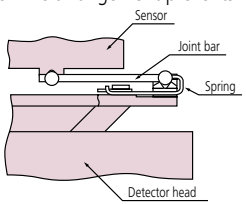
Linear Scale evaluation methods

- **Testing within the operating temperature range**
  Testing has proven that there is no abnormality of functions and signals when the Linear Scale is used within the specified operating temperature range.
- **Temperature cycle (dynamic characteristics) test**
  Testing has proven that there is no abnormality when the Linear Scale is used under the condition where the ambient temperature continuously changes within the specified range.
- **Vibration test (Sweep test)**
  Testing has proven that the Linear Scale functions without abnormality when subject to vibration within the frequency range 30Hz to 300Hz at a maximum acceleration of 3g.
- **Noise test**
  In accordance with the EMC Directives, EN61326-1+A1:1998
- **Crate Drop Test**
  In accordance with the heavy equipment drop test (JISZ0200) specified in the JIS standard.

Constructional features of the Linear Scale

Joint Structure of Detector

A ball joint structure is employed at the contact area between the detector head and the slider (sensor unit) inside the scale. This arrangement prevents the slider movement from deviating from the normal moving directions when the detector head is slightly misaligned transversely, thus providing a normal scale reading and increasing flexibility in the scale installation. In addition, this structure is highly rigid and therefore has excellent durability.



Water-proof Connector

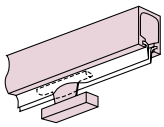
A waterproof/splash-proof connector is used to enable separation of the signal cable. Thus, installation and maintenance of the Linear Scale can be easily performed. (The signal cable on the AT115 cannot be separated.)

Conduit armored type signal cable

The signal cable is protected by the conduit system. Its exterior is made of stainless steel, which is corrosion-resistant and withstands continuous use.

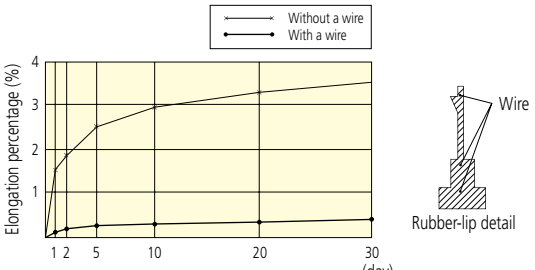
Unique rubber seals

The slider is shaped to glide smoothly through the rubber-seal opening – almost like the keel of a boat through water.



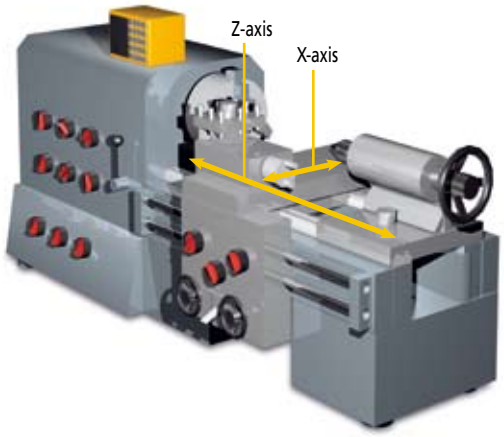
Excellent splash- and dust-proof rubber-seal structure

The rubber seals are made of a strong, special urethane, and wires are inserted in these seals to improve the splash-proofing and dust-proofing of the scale (AT103 only).

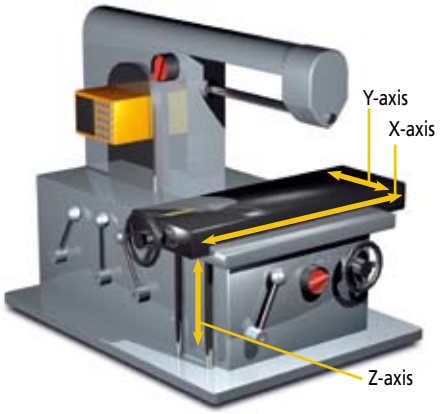


Elongation characteristics of dust-proof rubbers immersed in coolant

Scale systems for various multi-axis machine tools

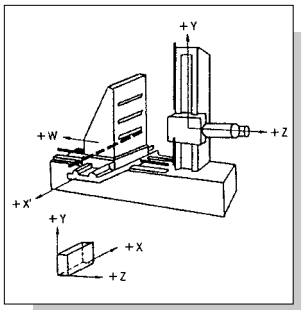


2-axes KA counter + two scales

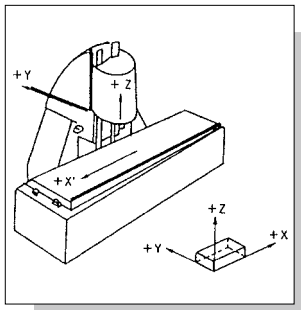


3-axes KA counter + three scales

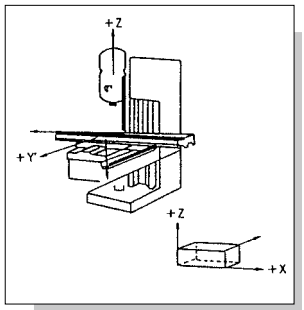
Horizontal boring and milling machine



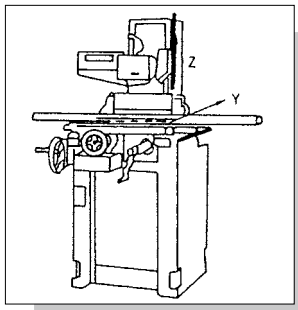
Bed-type milling machine



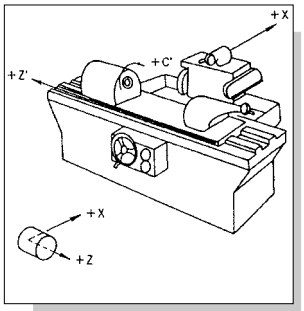
Knee-type milling machine, drilling machine, and jig boring machine



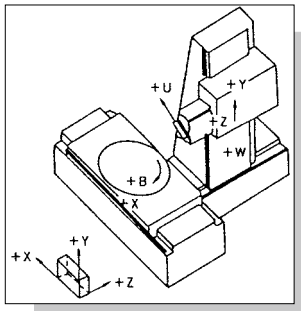
Grinding machine



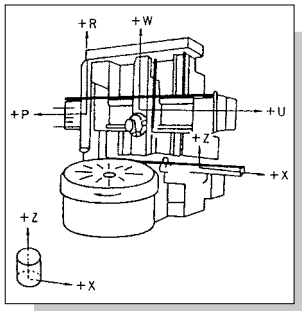
Cylindrical grinding machine



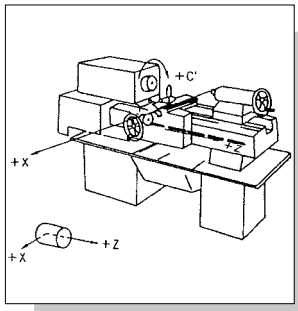
Horizontal boring machine



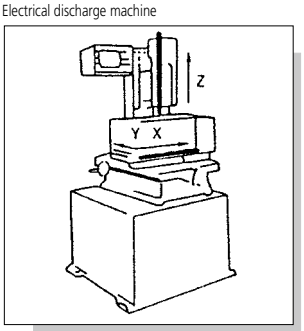
Vertical turret lathe, vertical lathe



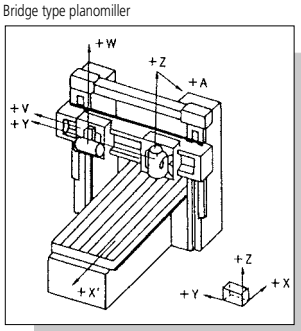
Centre lathe



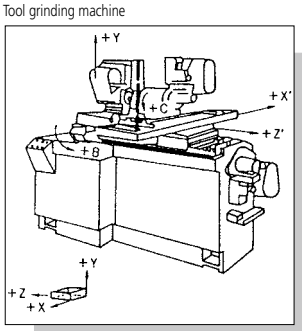
Electrical discharge machine



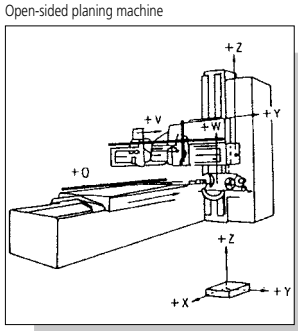
Bridge type planomiller



Tool grinding machine



Open-sided planing machine



DRO Systems

Specifications are subject to change without notice.

Export permission by the Japanese government may be required for exporting our products according to the Foreign Exchange and Foreign Trade Law. Please consult our sales office near you before you export our products or you offer technical information to a nonresident.

- Coordinate Measuring Machines
- Vision Measuring Systems
- Form Measurement
- Optical Measuring
- Sensor Systems
- Test Equipment and Seismometers
- Digital Scale and DRO Systems
- Small Tool Instruments and Data Management

Mitutoyo Corporation
20-1, Sakado 1-Chome,
Takatsu-ku, Kawasaki-shi,
Kanagawa 213-8533, Japan
T +81 (0) 44 813-8230
F +81 (0) 44 813-8231
http://www.mitutoyo.co.jp

Mitutoyo

Note: All information regarding our products, and in particular the illustrations, drawings, dimensional and performance data contained in this pamphlet, as well as other technical data are to be regarded as approximate average values. We therefore reserve the right to make changes to the corresponding designs, dimensions and weights. The stated standards, similar technical regulations, descriptions and illustrations of the products were valid at the time of printing. Only quotations submitted by ourselves may be regarded as definitive.

060 1212 (1) C-(PA) HS, Printed in Japan